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# **Science & Technology**

***China***

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## SCIENCE &amp; TECHNOLOGY

## CHINA

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Development of China's First Electron-Positron Collider Detailed

40080145 Hong Kong LIAOWANG in Chinese No 13, 23 Mar 88 pp 18-20

[Article by Gu Mainan [7357 6701 0589]: "Birth of China's First Electron-Positron Collider"]

[Text] On 7 October 1984, Deng Xiaoping placed the cornerstone for the Beijing electron-positron collider project. Since then, hundreds of factories and research institutes have worked hard day and night. To date, this project, which consists of thousands of pieces of sophisticated equipment and occupies nearly 100 mu in area, is near completion. The technical staff is working vigorously to complete the testing work in order to begin electron-positron collision according to plan.

The advent of the high-energy accelerator created a new era for particle physics. Scientists describe the power of this type of accelerator as equivalent to the energy of 10,000 suns.

In 1953, scientists at Columbia University in the U.S. developed the world's first high-energy accelerator. Since then, five accelerator centers have been built on the east and west coasts of the U.S.

Because of the usefulness of the collider, Chinese scientists were determined to build one for China. This is a very difficult task. Several generations of scientists have devoted their effort to it. To date, the following incidents that happened in the 1950's are still vividly remembered by people in the physics community:

In 1950, on his voyage back from the U.S., Chinese physicist Zhao Zhongyao [6392 1813 1031] was detained in Yokohama, Japan because he purchased some equipment to build a small, high-pressure static accelerator at the request of the Chinese government. The purpose was to build a foundation to perform experiments in nuclear science.

The news soon travelled all over the world. The Chinese government immediately issued protests on radio and in newspapers.

One year later, a young accelerator expert, Xie Jialin [6200 1367 7792], boarded a vessel in San Francisco to return to China. He was also held by the U.S. Xie Jialin did not give up and stayed in the U.S. to continue his research on accelerators. He knew that the technology he learned would be useful after he returned to China. He was engaged in the development of the first linear electron accelerator for the treatment of cancer. Later, through the assistance of the Chinese government, Xie Jialin finally returned to China in 1955.

As a matter of fact, the few boxes of so-called "atomic secrets" carried by Zhao Zhongyao and Xie Jialin were simple parts required to build a low-energy accelerator. This was the beginning of China's attempt to build a collider.

Since the middle 1950's, for a decade the Chinese government spent 20,000,000 yuan annually to send a team of experts led by Wang Ganchang [3769 3237 2490] and Zhang Wenyu [1728 2429 5940] to the Dubna Joint Institute of Nuclear Research in the Soviet Union to conduct nuclear physics research using a medium-energy accelerator.

In 1964, China was unable to access an accelerator in other countries. On the eve of the return of the scientists from Russia, Premier Chou Enlai was there on a visit. He listened to their complaint about the treatment and then indicated that high-energy physics should be done inside China. After the Chinese scientists returned, Vice Premier Chen Yi and Nie Rongzhen were determined to build a high-energy accelerator in China and told the relevant department to start the preparation. It was interrupted by the cultural revolution.

There was no high-energy accelerator in China. Zhang Wenyu went through a lot of trouble to build a cosmic ray observation station in Luoxueshan, Yunnan. A heavy particle with 10 times the mass of a proton was discovered with this equipment in 1972. Nevertheless, the data was not nearly as accurate as one could obtain with a high-energy accelerator. Therefore, the finding could not be confirmed.

Premier Chou was very interested in this discovery. He personally visited the station 7 to 8 times. At that time, Dr C.D. Lee was visiting China. Premier Chou discussed this discovery with him and asked for his opinion. He suggested that China build a small electron-positron collider. He said that a great deal of studies could be done with the collider with very little investment. His recommendation was enthusiastically supported by Premier Chou and scientists in China. That fall, 18 scientists from the Institute of High Energy Physics of the Chinese Academy of Sciences jointly wrote a letter to Premier Chou to recommend the construction of a high-energy accelerator. In his reply, Premier Chou pointed out that this issue should not be delayed further. The Academy of Sciences had to be responsible for the basic science and theory, and studies on high energy physics and accelerator development should have priority.

However, it was very difficult to implement this instruction. First, the "gang of four" bitterly opposed it. They claimed that the Chinese had a hard time feeding the people, there was no reason to build an accelerator. They even said that if the project failed it would only produce some scrap metal.

Under the leadership of Premier Chou, people like Zhang Wenyu overcame a lot of difficulties to prepare for the development of China's first high-energy accelerator. Although they worked very hard, they made very little progress because of lack of experience and disruption caused by the "gang of four."

On 13 October 1973, during the visit of Chinese American scientists Wu Jianxiong and Yuan Jialiu, Premier Chou asked Zhang Wenyu, "What kind of progress has been made on the preliminary development of the high-energy accelerator?"

"Not very much. It is slow."

"That is not good. There are only 2 years left in the Fourth Five-Year Plan." At the end, he repeatedly instructed Deputy Director Wu Youxun [0702 2589 6064] of the Chinese Academy of Sciences and Director Zhang Wenyu of the Institute of High Energy Physics to remove all obstacles to come up with a development plan for a high-energy accelerator.

The scientists were touched by the concern and expectation of the Premier. After numerous discussion, under the leadership of Yu Qiuli [0151 4428 6849], the State Planning Commission officially presented the "Report on Problems Associated With the Development and Construction of a High-Energy Accelerator" to the Central Committee of the Chinese Communist Party in March 1975.

Deng Xiaoping, who was responsible for Party Central operations, approved this report and forwarded it to Premier Chou. Premier Chou was seriously ill. He personally reviewed and approved this report while in the hospital. This is the "75-3" project. When the scientists were told by Zhang Wenyu about the news, they all cried. They were both excited and sad. They realized that this might be the last thing Premier Chou could do for high-energy physics in China. He was so sick but still concerned about building an accelerator. The scientists were determined to overcome all difficulties to succeed.

However, things still did not move smoothly. Someone compared the construction of a high-energy accelerator to the building of the Great Wall. It required the coordination effort of countless technical staff members to be successful. In the "10 years of chaos", people could not work. Despite crates of drawings designed by the scientists, it was still on paper.

In the decade from the early 1960's to the collapse of the "gang of four", China's first accelerator was begun and halted six times. Was the dream of several generations of Chinese scientists ever going to come true?

After the "gang of four" was crushed, especially after the Third Plenum of the Eleventh Congress, the construction of China's first accelerator was on track. In the Chinese National Science Conference, the Chinese Communist Party Central and the State Council announced the construction of a 50 BeV proton synchrotron. During his visit to the U.S. in early 1979, Deng Xiaoping and President Carter worked out the first Sino-American technical cooperation agreement--the Sino-American high-energy physics cooperation agreement. It was signed by Chairman Fang Yi of the State Science and Technology of China and the Secretary of the Department of Energy of the United States.

However, there were problems along the way. When the economic policy was adjusted in 1981, the accelerator project was put on hold again.

Later, whether China should or should not and could or could not successfully build its own high-energy accelerator was a controversy in the world. People in opposition believed that the construction of an accelerator should be done by a developed nation and China did not have the capability to build it.

After listening to all the opinions, Deng Xiaoping said decisively, "I think it is not a mistake."

In December 1983, in a Central Secretariat meeting, it was decided to include the construction of a 2.2 BeV positron-electron collider in the western suburbs of Beijing among key national engineering projects. In addition, it required that beams be generated in the Beijing collider in 1987 and positron electron collision be realized in 1988. The project code name was "8312". The Party Central appointed Gu Yu [6253 5038], Zhang Shou [1728 1108], Lin Zongtang [2651 1350 2768] and Zhang Baifa [1720 4101 4099] to lead the Beijing Positron-Electron Collider Engineering Team. It was proven to be an effective organization which was well recognized in the world.

The collider was to be built on the foot of Babaoshan in the western suburbs of Beijing. The 213 farming families living on the 100 mou of land moved away in a little over a month after learning that a key national project was to be built on their land.

Project "8312" affected everyone from the Party Central to worker and farmer. It also affected every Chinese overseas.

When the high-energy accelerator was still in preparation, at the airport in Beijing, C.N. Yang shook the hand of Zhang Wenyu and said, "I am pleased to give you this volume of paintings, especially the words I wrote on it." The cover of the book reads "Dear Wenyu, I sincerely wish you success in the construction of a new experimental base. I shall continue assisting you to the extent possible."

In May 1984, Professor C.D. Lee, who had been interested in the project for years, came to visit. He told Deng Xiaoping that "China is building three accelerators, one in Beijing, one in Hefei, and one in Taiwan. They are all scheduled to be completed in 1988. It is a race."

Some days later, Deng Xiaoping met Professor Samuel Ding in Beidaihe. Someone brought up the "race" again. Deng was excited and said, "O.K., let us have a race."

The news that China planned to build its first high-energy accelerator in 4 years spread around the world. People were waiting for it.

It has been said that a high-energy accelerator is a window through which the industrial and scientific standards of a country can be seen.

Under the guidance of the major technical equipment leading group of the State Council and the collider engineering leading group, relevant departments from 17 ministries and commissions formed the "8312" equipment coordination group. Over a hundred factories and institutes all over China were put into action by their ministers. A powerful force was forged and thousands of people were brought into the project. Many scientists vowed not to leave the country before the collider was finished. In order to make certain special parts needed, some retired workers went back to the shop to work. Young people postponed their wedding dates.

The key people in a shop at the Shanghai Aircraft Factory overcame all sorts of family and living difficulties and went to Beijing to assemble the shower detector. They stayed for months.

In Beijing, the Broadcasting Equipment Plant was responsible for the 100 kW high-frequency generator. A dozen technical personnel gave up their Chinese New Year holidays to work on a day and night shift. The machine finally completed the test of 720 hours of continuous operation.

In Tianjin, workers in the Xinhe Shipyard on the shores of Bohai built a giant magnet for the mass spectrometer in very cold weather.

The 4404 Ordnance Factory mobilized the entire plant to produce 16 high-power klystrons in 18 months.

In Guizhou, Fenghua Machine Factory of the Ministry of Aerospace Industry undertook a very difficult task which had never been attempted before. It involved the vacuum welding of a 6-7-meter-long box. American experts praised the job after they looked at it.

Everything was moving along vigorously.

In spring 1987, pieces of equipment were shipped to Beijing.

At midnight on 17 December 1987, a beam was generated in the collider for the first time. From Deng Xiaoping placing the cornerstone on 7 December 1984 to producing a beam on 17 December 1987, it took only a little over 3 years. However, it was still a very difficult task to realize positron-electron collision. Scientists who waited for the accelerator for decades worked day and night in the tunnel to carefully adjust various parts to fight for the successful electron-positron collision.

The comforting thing is that China has built a team to build high-energy accelerators. Professor Fang Shouxian [2455 1343 6343], who is responsible for the collider project at the Institute of High Energy Physics in the Chinese Academy of Sciences, is prepared to visit Brazil to discuss the prospect of building an accelerator for that country.

12553/7310

Academy of Sciences Sets Up S&T-Driven Enterprises

40080170 Beijing RENMIN RIBAO in Chinese 22 Jun 88 p 1

[Text] (Xinhua News Agency)--The work of China's largest scientific research group, the Chinese Academy of Sciences, has already expanded from the scientific field into the economic field. At the Sino-American Industry, Trade and Economic Development Seminar being held here, CAS Secretary General Hu Qiheng said that from now and for a very long time the Academy will not only have a comparatively high-level system of research organizations, but also a group of science and technology driven enterprises. She indicated that the Academy is willing to become a partner in direct cooperation with foreign financial and commercial worlds. Based on the briefing, the Academy presently has established a comprehensive cooperative relationship with 20 provinces and municipalities nationwide. Branch research organizations distributed around the country have established, one after another, nearly 400 small enterprises, the vast majority of which are managed in cooperation with the local authorities or enterprises. The Academy has also established a group of enterprises closely related to biotechnology, micro-electronics, materials science, information technology and laser technology. More than 30 are managed with foreign cooperation.

For the purpose of spurring the Academy's progress in opening up the economic field and expanding cooperation with foreign countries, Hu Qiheng announced eight forms of cooperation with foreign interests. Including are the following:

1. The Chinese Academy of Sciences has a group of comparatively high-level scientific research organizations engaged in basic research. They are willing to contract with foreign enterprises to undertake designated research responsibilities. The achievements of their research could first be turned over to the contracting foreign enterprises. If both sides agree through consultation some research organizations may concurrently assume the functions of the foreign enterprise's R&D department.
2. China is rich in botanical resources. From these resources very many particularly useful materials can be extracted. Plants with medicinal uses are one example. The Academy can take responsibility for extracting medically useful substances and producing samples from them. Foreign companies would be responsible for clinical testing and organization of production.



3. Some transnational corporations have established throughout the world subsidiaries responsible for research, development, production, sales and maintenance. Companies which have been set up by the Academy and its affiliated organizations could become the key enterprises of these regional subsidiaries, assuming responsibility for technological product research, development, production, or maintenance.

4. Certain of the Academy's enterprises can provide foreign companies with OEM products, process foreign-supplied materials, and take on technical as well as project contracts.

5. The technology of foreign enterprises can be brought together with the superior manpower and resources of China, to establish small to medium-sized S&T driven enterprises, and cooperatively develop new products, so as to strengthen competitiveness in the international market.

6. Both sides would jointly invest, the Academy would provide competitive technology, raw materials, and organize production. Foreign enterprises could provide advanced management techniques and take responsibilities for opening up markets, so to effect cooperation centered on production.

7. The Academy and foreign partners would jointly set up high risk small to medium sized enterprises, and based upon need and feasibility, commit certain funds and the required technology.

8. The Academy can also come together with foreign enterprises and local Chinese enterprises to batch produce certain products which use applicable technology.

13466/9986



'Science Village' Gears Research to Future Markets

40080173a Beijing RENMIN RIBAO in Chinese 13 Jul 88 p 3

[Article by Xiao Guanggen [5618 7070 2704]: "A New Incubator of High-Tech Enterprise"]

[Text] Jiading Xian in the suburbs of Shanghai has a number of "science villages" of which Dongchen is the best. Dongchen is located 5 kilometers southeast of the county seat and is the smallest village in Jianbing Xiang. It has a population of 1,100, the average farmland per person is less than 1 mou, and transportation is very inconvenient. The village party secretary Pu Gongzheng [3184 0361 2973], 42, introduced the village situation to us. From a drawer he pulled out a printed document entitled "Rely on research units to vitalize the village industry." He read from the text: "We realize that in order to make the peasants prosperous we must work on industry and agriculture simultaneously. However, in order for the village industry to survive and grow, we cannot rely on one or two products. We must have alternative products and continue to develop new ones. It is hard for village industry to develop new products because of the shortage of manpower. Of the more than 600 workers in the village, not one had a college education. We then thought that Jiading, being a satellite city of science with a number of national laboratories, must have abundant technical people, research results, and new technologies. If we could link up with them, then we would not have to worry about the lack of new products."

This was indeed the case. Now the five plants and ten shops in Dongchen Village are all closely related to research units, and some of the plant and product names are very impressive. For example, the Dongchen Electronic Device Plant, Shanghai Institute of Silicates, has two products. The quality of the lithium niobate crystals is the best among the 40-odd plants in China and is the equal of similar foreign products. This line of products brings in more than 400,000 yuan in profit every year. Special industrial ceramic alumina is a new material used in high-temperature technologies. A new type of alkaline battery diaphragm is being produced by the Dongchen Battery Material Plant, Shanghai Nuclear Institute. This item is a first in China and has wide applications in the high-tech arena. As of now, only the United States and China can produce this product and more than half of China's output is sold overseas. Recently, a company in Hong Kong came to China and signed a cooperation agreement. The production will be doubled to meet the market demand.

Dongchen Village is actually an incubator of high-tech enterprises. There are a number such incubators among the 17 research-production consortiums in Jiading County.

When we had lunch at Dongchen Village, Pu complained to me about the difficulties he had encountered. He said that for 3 consecutive years Dongchen had made more than 1 million yuan in profit, and yet he added that he had no money to use and was deeply in debt. The reason is that technological developments take large investments and may not show short-term benefits. In 1988 the Battery Material Plant is building a new cobalt source and Dongchen is investing 850,000 yuan. The Electronic Instruments Plant is building a new high-temperature shop, which requires an investment of 600,000 yuan. The village has invested 1.35 million yuan in the battery diaphragm by taking out a 1.15 million yuan loan. The village has taken out a total of 1.80 million yuan in loans. The battery diaphragm is expected to create a profit of 400,000 yuan and \$250,000 of foreign exchange, but not much of it will reach the village. The neighboring village has two enterprises that produce old products and are sure to make 300,000 yuan without capital investments.

"But in the long run your investments are still worthwhile," I said. Pu nodded his agreement, and added that "If not for the market potential 5 years from now, I would not for the life of me spend this much money." Pu's comments show that rural industrialists are willing to invest in science and technology because they have their eyes on the world market. We found the same thing in a meeting with villagers and cadres of Fangtai Xiang. The cadres put it explicitly that village enterprises must achieve two transformations, changing from inward looking to outward looking and changing from labor intensive to technology intensive. Only technology intensive products can get a foothold in the international market. Gulei Village contributed 40,000 yuan to the Shanghai Institute of Optics and Fine Mechanics as early as 1980 for the development of portable X-ray machines. The machines were certified in December 1987 and 17 youths from the village received technical training. This type of X-ray machine has not been made either in China or overseas. The villagers decided to manufacture them and place them on the market as soon as possible.

Another problem in Jiading is the shortage of labor. The county now has 10,000 workers from outside and the average income of workers is increasing every year. According to data provided by the county science and technology committee, the total investment of the 17 research-production consortia in the county is 16.92 million yuan, out of which 60 percent is provided by the agricultural sector.

On my way to the Shanghai Institute of Optics and Fine Mechanics, I noticed a sign on a building that read "Lei-Ou laser plant." Mr. Zhang Jiling [1728 1015 2651] of the Development Department of the Shanghai Institute told me that the Lei-Ou plant is operated jointly by the Institute and Jiayi Xiang. The plant has just added an assembly line for CO<sub>2</sub> lasers that turns the accumulated laser research results into products and absorbs 18 technical staff members. Zhang said that the Institute has decided that from now on all the research results will be turned into products in Jiading. So far they have built seven plants. I was told at the Shanghai Nuclear Institute that they too would like to develop

their results in Jiading. Even the Shanghai Institute of Silicates and the Shanghai Institute of Metallurgy located in the city have also established intermediate test plants in Jiading and have developed a number of new products. What makes these research institutes of the Chinese Academy of Sciences transferring high technologies to the villages? Zhang Jiling put it succinctly: they are "forced" and "attracted" to the villages. The technology policy reform gradually takes root so that the research departments can no longer rely on "allocations." They are forced to find new routes that combine technology and production; in this regard, the rural area is much more attractive than the city.

First, the rural policies are versatile and the research units are treated favorably in terms of economics. Secondly, the rural areas are more efficient and things can be done much faster. As long as the leaders of a village are for the project, the project will move along without delay. More importantly, know-how and the technical personnel are respected and the wages have been raised. The average income of the 64 technical staff at the 7 consortiums established by the Shanghai Institute of Optics and Fine Mechanics has doubled.

9698/08309

## New Technology Development Zone in Beijing

### Funding, Pricing, Trade

40080162b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21,  
1 Jun 88 p 29

[Text] Editor's note: After the news came out that the Central Committee had decided to set up the New Technology Development Experimental Zone in the Haidian District of Beijing, this prompted a strong reaction throughout the country, as other areas have prepared to construct similar science and technology development parks, and this has attracted attention abroad as well. To allow everyone to more clearly understand the characteristics of this new technology development zone, we have arranged for this special edition on the New Technology Experimental Zone at Zhongguancun to publicly report the news about preferential policies concerned with the Experimental Zone, the current situation, and background materials to satisfy readers.

Implementing preferential policies to create an ideal environment.

The healthy development and flourishing prosperity of the New Technology Development Experimental Zone will require an ideal environment. It is understood that the state will implement a series of preferential policies for the development and construction of the Experimental Zone.

### Government Taxation

The state is carrying out a policy of tax reduction for new technology industries within the Experimental Zone. Temporary provisions for the Experimental Zone hold that there will be a 15 percent reduction in collections of income tax for new technology industries, and a 10 percent reduction in taxes for those enterprises for which export products are 40 percent or more of the gross output value of the enterprise for the year in question; within three years from the day they open, new technology enterprises are exempt from income taxes; privately funded business space for new technology production and operations and attached facilities that are part of them are exempt from taxation; it is also clearly provided that new technology enterprises within the Experimental Zone that manufacture "integrated circuits, computers, software, and program-controlled exchanges" will be provided with tax advantages.

## Funding and Financing

Banks will provide support through loans to new technology enterprises within the Experimental Zone. New technology enterprises that are foreign-oriented will be given preference for obtaining loans in foreign exchange. During the first three years of the establishment of the Experimental Zone, the People's Bank will provide loans on an item basis for use in the development and construction of new technology enterprises in the zone; after deposits at professional banks in the Experimental Zone have completed pay back and have reached an obligatory level of reserves, greater benefits will accompany greater savings. That portion saved over obligations is all available for use, and is to be used for new technology enterprises; loans for new technology enterprises within the district will not be further divided into fixed capital and circulating capital, but rather all will be treated as developmental loans; banks within the district can withhold a certain proportion of profits to set up loan risk funds, and to set up a Sino-foreign jointly funded risk investment company to serve the more risky ventures.

## Import-Export Trade

The Experimental Zone will set up new technology import-export companies that will have independent accounting and autonomous operations, will be responsible for their own profits and losses, and that will be legal entities in dealings outside China. Raw materials and components to be imported as needed by enterprises to export products will not require import licenses; with Customs approval, tax security depositors will be set up in the Experimental Zone to supervise imported raw materials and components, as well as to exempt from import customs taxes and linking taxes or value-added taxes in accordance with actual export quantities processed, and export commodities are exempt from export customs taxes; instruments and equipment needed to be imported for use by new technology enterprises for new technology development will be exempt from import customs taxes for a 3-year period; the Experimental Zone will establish an office of specially appointed personnel of the Ministry of Foreign Economic Relations and Trade who will be responsible for reviewing, approving, issuing, and retracting import-export licenses for new technology enterprises; qualified new technology enterprises will be granted authority to operate outside the country, and with state permission will be allowed to establish branch organizations abroad. Foreign exchange generated through the export of commodities will not need to be turned over to the government for 3 years. After the 3 years, under the premise of being responsible for their own profits and losses, the local government and the foreign exchange generating enterprise will divide the foreign exchange by two parts and eight parts, respectively; for enterprises with economic and technological exchanges outside China and that are doing greater volumes of commodity export, their business and technical personnel may leave the country several times a year, and will be able to process their own applications.

## Commodity Pricing

Test marketing prices for new products developed by new technology enterprises in the Experimental Zone can be determined by those enterprises, and prices may also be set for those new technology products for which the state has no unified price.

## Skilled Personnel and Allocations

To encourage scientific and technical personnel in scientific research units, schools, and enterprises to hold concurrent jobs and to start up operations, as well as to head operations at new technology enterprises in the Experimental Zone, and to contract to new technology enterprises of the new mold, it will be permissible for new technology enterprises to be responsible for recruiting employees of all categories, there will be no limit to the number of workers that can be employed, and the objectives of employment may be self determined. Skilled personnel exchange service centers will be set up in the zone to take charge of handling the various personnel procedures and facilitating relations in all aspects. As far as allocation is concerned, new technology enterprises in the Experimental Zone are exempt from taxes on enterprise bonuses, can make allotments in accordance with efforts, and are permitted to retain various allocation systems.

### Separate from SEZ

40080162b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21,  
1 Jun 88 p 29

[Article: "The New Technology Development Experimental Zone in Beijing Is Separate from the Coastal Special Zones"]

[Text] As described by the departments involved here, the State Council has permitted the newly founded New Technology Development Experimental Zone in Beijing Municipality to be fundamentally separately from the special economic zones in the coastal area.

This Experimental Zone is a professional new technology zone, and although it encompasses an area of 100 square kilometers, it is not a prefectural zone. It has been established on the basis of "new technology," and only enterprise and public agency units engaged in the creation, development, and production associated with new technologies will be the recipients of the various preferential policies for the Experimental Zone. Even though other enterprises might be within the district, they cannot share in these policies. In the coastal zones, any enterprise within the confines of the zone can share in policies relevant to the zone. This is a fundamental distinction.

Secondly, distinctions within the Experimental Zone will be made differently than is true in the coastal special zones. Coastal zones, such as that in Shenzhen, and including the Tianjin Economic Development Region, were all created from virgin land, arranged uniformly, uniformly laid out, and

uniformly planned. Plants in the 100-square-km New Technology Development Experimental Zone at Zhongguancun are scattered all over the place, there is hardly a vacant piece of land, and the only way the appropriate kind of transformation is going to take place is by wholesale demolition.

In addition, there are many scientific research organizations in the Zhongguancun area, and enterprise and public agency units running enterprises will be faced with different situations than those doing the same thing in the coastal special zones. Within the Experimental Zone there could be different systems, different taxation systems, different allocation systems, and different personal systems even within the same unit. Running enterprises from your front door can have its advantages, but there are also various contradictions. Much effort must be exerted to alleviate these, and this, too, is an aspect that cannot be ignored.

#### Focus on Computers, Electronics

40080162b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21,  
1 Jun 88 p 29

[Article: "New Technology Enterprises in the Experimental Zone will still focus on Electronics and Computer Technology"]

[Text] There are currently 148 science and technology enterprises in Zhongguancun, and broken up by industry, there are 97 electronics and computer technology development enterprises, or 65.6 percent; there are 12 new materials enterprises, or 8.1 percent; there are 7 biologic engineering enterprises, or 4.7 percent; and 32 chemical engineering, instrumentation, and other enterprises, or 21.62 percent. As far as operations income is concerned, the electronics and computer enterprises account for 85 percent and more, and for this reason the electronics and computer areas are in a leading position, whether considering number of firms or operations income. For the last few years, Zhongguancun has been the largest marketplace for computers and their components in China. From 1984 through 1987, there were more than 400 million yuan in sales of computers, and this area trained 33,000 technical personnel for all of China. One company alone, Kehai Company, offered more than 150 different lectures, and in 1987 the sales volume for the Sitong [Stone] Group Companies ranked first among the ten largest computer enterprises in China. Most enterprises in Zhongguancun began with computers, and at present nearly all the well known enterprises there are engaged in computer development and operations.

#### Management Office Established

40080162b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21,  
1 Jun 88 p 29

[Article: "Capable, Highly Efficient Experimental Zone Management Organizations Will Be Established"]

[Text] As described by departments involved, the Haidian District of Beijing Municipality is preparing to set up an Experimental Zone office. The office has been designated at the secondary prefectural level, and will be fully



responsible for all specific affairs having to do with the New Technology Development Experimental Zone. The office will be capable and highly efficient, as the office deputy manager, responsible persons in each department, and working staff will be recruited from society at large.

#### Ideology Behind Zone

40080162b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21,  
1 Jun 88 p 29

[Article: "'Transfer, Incubate, and Spread'--the Idea Behind the Experimental Zone"]

[Text] The global new technology revolution is pressing the growth of new technology and of high technology, and our drive toward modernization requires the impetus of new technology and high-level science and technology. For the past 30 years, science and technology in China has progressed rapidly, but we have never discovered the means through which to rapidly transform science and technology into production forces. The Zhongguancun "Electronics Street" that has sprung up in recent years has been an inspiration. The New Technology Development Experimental Zone in Beijing Municipality has been established on just this basis, with approval of the State Council. This Experimental Zone is a high-level science and technology zone that is outward-looking and unrestricted. In accordance with the principle of "transfer, incubate, and spread," it is undertaking an experiment to explore possible paths by which Chinese high-level science and technology and new technology can be expeditiously transformed into production forces as it advances the direct integration of science and technology with production, as well as the optimum combination of science and technology with other production factors. The Experimental Zone will become the incubator and source of diffusion from which these things will spread throughout the country to spur us on.

#### CAS' Computing Company

40080162b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21,  
1 Jun 88 p 30

[Article by Liu Chuanzhi [2692 0278 1807], general manager of the Computing Institute Company of the Chinese Academy of Sciences: "Forming a Sizable Economy, and Creating a New World of Associations"]

[Text] Three years ago, stimulated by the resolution by the Central Committee regarding the restructuring of the science and technology system, a dozen or so of the research personnel at our institute left the institute to form a small company associated with us, for which effort there was only 200,000 yuan at that time. Today, we have grown into a fledgling company of 230 personnel, the output value for which was 70 million yuan last year.

The Central Committee is now proposing a strategy for the development of the coastal economy, which requires us to initiate high-level science and technology industries that look beyond China. It has also provided for the



establishment of the Beijing New Technology Industrial Development Experimental Zone centered on the Zhongguancun District, which will point out directions for our future development and provide excellent external conditions. For several years, we have cherished a beautiful desire, namely, we have hoped that one day a computer that we have developed and produced on our own that can compete in international markets.

We know quite well that under our current conditions and levels there is still a great distance between what the Central Committee is requiring of us and the realization of our dream. If we are to create a significant economy, an annual output value of 70 million yuan is nothing to speak of, and our company must grow in a direction outside our borders. We still lack an understanding of international markets, and we lack the capacity and funding through which to manufacture our own products in large quantities. But we are full of confidence regarding the fulfillment of our ideals, and those goals we have set for ourselves include struggling for ten years so that before the end of this century we will have formed a significant economy and created a new world of associations.

After much thought, we consider that regarding this point about forming high-level science and technology industries that look outward, we have certain advantages.

The greatest among these is that we are not a flock of shortsighted birds, but rather are a fighting group with far-reaching ideals and fierce senses of mission and responsibility.

This year, we have formulated four ourselves the limited target of achieving an output value of 130 million yuan, and we are taking the following measures as safeguards:

1. We have set up in Hong Kong a joint-venture company with a local enterprise. We have established a marketing service center in Singapore to increase our understanding of international markets, to comprehend the trends in international economic development, and to foster the skilled personnel, funding, and experience necessary for growth outside our borders.
2. In places like Shenzhen, Zhuhai, and Shazhou we have set up our own production bases so that domestically made products might be made international as quickly and to as great an extent as possible and so that we can strengthen our own productive power. This enhances our capacity for competition and lays a good foundation for the eventual realization of batch production of our own computer.
3. In 26 provinces, municipalities, and autonomous regions throughout China we have established marketing service centers for the greater convenience of customers and to improve the quality of our service.
4. We have further improved various management systems within our company to improve the level of management, to improve working efficiency, and to fully arouse an enthusiasm for work among all the personnel in the company, which will bring about the maximum realization of their intelligence and abilities.

5. We have further improved the quality of the personnel of our company, expanded out contingent, and we want especially to give precedence to the supplementing of specialized personnel in the aspects of finances, accounting, foreign trade, and management to meet the needs of the growth of our operations.

#### Planning, Restructuring

40080162b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21,  
1 Jun 88 p 30

[Interview with Zhou Mingtao [0719 2494 7118], general manager of the Xiwang Computer Company: "Can Today's Expectations Become Tomorrow's Reality?"]

[Text] Zhongguancun is going to erect a high-level science and technology enterprise park oriented outside of China, which will cause the already active street that is Zhongguancun to simply erupt. Enterprises on this electronics street will be even more eager to get going, and the great plan is being unveiled. This reporter went for interviews with the Xiwang Computer Company general manager, Zhou Mingtao to ask him to talk about planning under the new conditions.

Zhou Mingtao told me that the restructuring here is our guidance by the highest level of leadership in China, and it is to allow his company and others like it to become high tech enterprises that look beyond China's borders. When he and other enterprise officials had first heard this news they got quite excited, but then quickly saw this as a kind of pressure, and a very strong pressure at that. Whether or not they are successful will not only affect his own enterprise, but will have something to say about whether this attempt at restructuring is correct.

After analyzing the path toward maturity of the Xiwang Company, he said that during previous growth of the company, the strategy that called for occupying a market share with one's own products was correct, but that exactly how to do that not clear. But now it is clearly realized that they have reached a new stage of growth, and during the past two or three years they have had nothing but increases in sales volumes, so it cannot be said that the enterprise has truly matured. He said that they want to establish our own industry and have their own foreign-oriented products. If this problem is correctly resolved, they will possibly have forever lost an opportunity to take off. In analyzing markets and competitive environments, Zhou Mingtao said that in the electronics markets, those enterprises that truly have reserves and competitiveness are those high-tech enterprises that have their own market-demand products and production capacity for them. The market at Zhongguancun over the past few years has been fundamentally what those enterprises having customer service and a technology backing have outlined, and now their opponents have brought about a change. Take for example units with production capacity and technical backing, such as those affiliated with the Ministries of Machinery and Electronics, and of Aeronautics and Astronautics, which may all come to the park to enjoy the preferential

policies, and whether the Xiwang Company is going to be able to grow successfully within an environment with that kind of competition will not be known for another two or three years.

Zhou Mingtao spoke to us emotionally about how they had not been thinking recently of how to do business, but rather of how to adjust their strengths and their systems to develop into enterprises that are oriented outside China's borders. The original structure of the Xiwang Company was that of technology trade, that is, they promoted their business through technical service. They had a low proportion of their own products, their technical system was Chinese character-based, and the market was domestic. As far as production organization and structures were concerned, together with their processing, they have never been involved with import-export. When talking about measures from now on, he said that they must expand their networks, establish an active marketing contingent, and cannot wait until they have products before setting up that contingent. As far as the software industry is concerned, they are thinking of joint-funding, and for hardware products they would have to work at more roundabout methods. If they seek a neutral position and use applied technology to enter international markets, the pace could be quite slow. They might consider becoming OEMs for some of their products.

As to whether the Xiwang Company can be successful in competition, Zhou Mingtao said quite confidently that with such an excellent peripheral environment as we now have, they will take yet another step toward restructuring, in which process they feel dominant in both timing and thinking.

#### Street Classification, Technology Categories

40080162b Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 21,  
1 Jun 88 p 30

[Article: "Classifications Established for Six Streets"]

[Text] It has been revealed by the departments concerned that the building of the Beijing Municipality New Technology Development Experimental Zone as approved by the State Council will be centered on Zhongguancun and that six streets will be built in the Haidian District: one in Zhongguancun, and the others as Xueyuan Road, Xueyuan South Road, Zizhuyuan South Road, one in Beitaipingzhuang, and another as Yongding Road. This reporter also understands that new technology industries of a similar sort will be more or less concentrated on the same street. The six streets just mentioned will be designated as the streets of electronics, the information industry, biological engineering, energy resources development, and building materials.

The 100 square kilometer New Technology Development Zone

The Beijing Municipality New Technology Development Experimental Zone will be centered on Zhongguancun and will carve out a section of the Haidian District that is 100 square kilometers. This area includes the area in the Haidian

District east to Deqing Road and Qiantun East Road, west to the Jingmi Viaduct and Yuquan Road, north to Xisanqi Road and Qinghe, and south to the Xinkai Canal. At the same time, an area about 2 square km has been designated in Yongfengxiang of Haidian in which to build an experimental industrial manufacturing district and intermediate testing base.

By the end of the year, the number of sci-tech enterprises in the Experimental Zone can reach 1000. Sources reveal that there are currently 150 sci-tech enterprises in Zhongguancun, and that after the New Technology Development Experimental Zone has been set up, that number will grow to 500. But it has been recently disclosed that 400 new enterprises are applying to register, and that by year's end this could reach 1,000.

There will be 12 categories of new technology in Beijing Municipality

A series of preferential policies for the New Technology Development Experimental Zone centered on Zhongguancun in the Haidian District of Beijing presume "new technology," and only new-technology enterprises engaged in high technology and new technology that is technology- and skill-intensive--or in the research, development, manufacturing, and operations of other new technology products that are suitable for development in the capital--will be able to enjoy the preferential policies. Beijing Municipality has divided new technology into the following twelve categories: 1. electronic information technology (including information processing software); 2. laser technology; 3. life sciences, biological engineering technology; 4. new materials technology; 5. new energy source technology; 6. environmental sciences and labor safety technology; 7. special building materials and new construction technology; 8. precision chemical engineering technology; 9. new medicines and biomedical engineering; 10. nuclear applications technology; 11. earth sciences, space technology, and marine technology; 12. and other new technologies that can bring in high economic results, can broadly permeate the economy and society, and suit the characteristics of the capital. The Beijing Municipality New Technology Development Experimental Zone will appraise and decide upon new technology enterprises for the Experimental Zone in line with these twelve aspects.

12586/7310

## An Overview of Fiber Crystal Growth and Applications

40090106a Beijing WULI [PHYSICS] in Chinese Vol 17 No 4, Apr 88 pp 203-205

[Article by Tan Zhongke [6223 1813 1870] of the Institute of Crystal Materials, Shandong University, and Li Guangao [2621 0385 0707] of the Department of Physics, Nankai University]

[Abstract] Generally a fiber crystal has a diameter within the range of 1 to 500  $\mu\text{m}$ , thus it is considered as a one-dimensional crystal. A fiber crystal finds unique applications in optical, electrical, and magnetic apparatus. Currently, this kind of crystal is mainly applied in optical apparatus, such as fiber-based lasers, amplifiers, polarizers and synchronizers. In nonlinear optics, monocrystalline fibers are used in modulators, switches, doublers, mixers and parametric oscillators. There are seven methods of growing fiber crystals: gas phase, gas-liquid-solid, solution, limited external shape, floating zone or small base, capillary feed melting (drawing or extrusion) and solidifying in capillaries. Of all these methods, the small-base growth method has the most advantages since it was successfully developed with laser heating (using a 50 W continuous-wave, 10.6  $\mu\text{m}$   $\text{CO}_2$  laser) by Stanford University and Bell Laboratories. As proven by repeated use, this Stanford (or Bell Laboratories) apparatus can melt any oxide rod less than 1 mm in diameter as shown in one of four figures in the text. Oxides and fluorides can effectively absorb 10.6  $\mu\text{m}$  radiation; therefore, a  $\text{CO}_2$  laser is very suitable for such materials. A good number of higher schools and research institutes in China are conducting research in this direction.

Three more figures show capillary suction drawing method for growing KRS-5 fiber crystals, pressurized capillary feed lift drawing of monocrystalline and laser-heated small-base method for growing monocrystalline fibers. References: 16, 10 in English, 5 in Chinese and 1 in Russian.

10424/6091

Electroreflectance Spectroscopy and Its Applications in Solid State Research

40090106b Beijing WULI [PHYSICS] in Chinese Vol 17 No 4, Apr 88 pp 206-210, 196

[Article by Wang Ruozhen [3769 5387 2823] of the Department of Physics, Beijing Normal University, and Zhao Mingshan [6392 2494 1472] of Qufu Normal University, Shandong]

[Abstract] Abbreviated as electroreflectance (ER), an electric field modulation reflected light spectrum is important in structural research into semiconductor energy bands, and material determination. As discovered in the past 2 years, light spectrum modulation approach can be important in research on electronic energy states in semiconductor superlattices and quantum wells. So light spectrum modulation is drawing intense researcher interest.

The ER spectrum is a spectrum capable of fine discrimination in studying solid state electrons; so this type of spectrum is one avenue of fundamental physics (coagulation state) research; its advantages lie in its usability at room temperature and in the visible light spectral interval. In addition, the method is very useful in fundamental applications research in analyzing solid materials. Compared to other large spectrographs, the experimental apparatus in this is much simpler, is nondestructive of samples and leads to a certain level of spatial discriminability. As found in recent years, the method has been proven to have vital functions in microstructural research on superlattices and quantum wells, thus evoking widespread interest among researchers.

Three figures show a comparison between the ER spectrum and general reflected light spectra, the experimental layout of the ER spectrum, and the variation of the imaginary component of the dielectric function. References: 11 in English.

10424/6091

Breakthrough in 'Stream Tube' Technology Reported

40080173b Beijing RENMIN RIBAO in Chinese 16 Jun 88 p 3

[Article by Wu Fumin [0702 1788 3046]: "Plastic Part for Stream Tube Successfully Developed"]

[Text] A comb-shaped plastic part for stream tubes, the newest high-tech scientific research product developed in China, has passed qualification at the Institute of High Energy Physics of the Chinese Academy of Sciences.

It was determined by plastics experts from the Chinese Academy of Sciences and from the plastics industry in China that the product has met manufacturing specifications of the muon detector of the position-electron collider under construction at CERN in Geneva. This achievement indicates that China's plastics technology has entered the international scientific research arena and has reached world standards.

This plastic product, developed by the Shanghai Institute of Plastic Products, has great potential for entering the international market of scientific research products. The Shanghai Institute was commissioned by the ALEPH International Cooperation Group of the Institute of High Energy Physics, Chinese Academy of Sciences, 2 years ago to develop this product. After 100 or so trials and a great amount of work in tool design, material formulation, and fabrication flow chart engineering, the product was finally developed in May 1988. The product is now mass-produced by the Shanghai Kailong Plastics Plant. The product quality rivals other similar products on the international market, and made China the second country after Italy to produce this item. This shaped plastic has a wall thickness of only 1mm and an accuracy of 0.1mm. The 8 meter-long tube must be straight and have clean inner surface. The Chinese plastics industry had to deal with unprecedented manufacturing specifications. The successful development of this item shows that China has made great strides in plastic extrusion technology in the past 2 years and now ranks among the leading countries in the world in this area.

9698/08309



## Study, Verification of HBV-Like Particles in Cow Sera

40081077 Beijing JIEFANGJUN YIXUE ZAZHI [MEDICAL JOURNAL OF CHINESE PEOPLE'S LIBERATION ARMY] in Chinese Vol 13 No 2, Apr 88 pp 98-100

[Article by Fang Yu [2455 1342], Wu Jianguo [2976 1676 0948], and Li Fangqiu [2621 5364 0948], Department of Clinical Immunology; and Yu Yiqiang [0827 3015 1730], and Zhang Taihe [1728 1132 0735], Electron Microscope Laboratory, Nanjing General Hospital of Nanjing Command: "Further Investigation of HBV-Like Particles in Cow Sera"]

[Text] Abstract: Thirty-five samples of cow sera were assayed for human HBV serological markers, 16 of which were found to be HBsAg and/or HBeAg positive, including six in which the immunoelectron microscope procedure found human HBV-like particles. Agar double diffusion of five of these samples and of horse anti-HBs sera showed 1 to 3 precipitation lines, one of which fused with human HBsAg. The  $^{32}\text{P}$ -HBV DNA dot hybridization method produced negative readings for all six of the polymeric human sera albumin receptors [PHSAR]. The above results suggest that the HBV-like particles in cow sera have some antigens in common with HBV, but not with human HBV.

Key terms: Hepatitis B virus, and dairy cows

Since the discovery in 1965 by Blumberg et al.[1] of antigens on the surface of hepatitis B viruses (HBsAg), discoveries continued to be made in 1978 and 1980 of woodchuck hepatitis virus, beechey ground squirrel hepatitis virus, and duck hepatitis virus[2-4] among woodchucks in the eastern United States, beechey ground squirrels in California, and Peking ducks in China and Japan. These viruses have many common features in terms of their antigen makeup, their morphological structure, and their biological characteristics. For example, they are all spherical granules with a diameter of between 40 and 50 nm; they are all made up of a virus outer shell and a hexagonally shaped core; they all have spherical or tubular surface antigen particles measuring between 15 and 25 nm in diameter; they all have endogenous DNA polymerase; their genome is partially a double-stranded circular DNA; they can cause persistent viremia and/or high concentration surface antigenemia in infected animals; the virus invades the liver primarily, and may also involve the heart, the spleen, and the kidneys.[5] In view of these characteristics, Robinson classified these viruses together as members of the hepatophilic DNA virus group.



Using immunoelectron microscope techniques, we discovered virus particles in cow sera that have a morphological structure similar to human HBV.[6] We have made a preliminary study of pertinent features, the results of which are reported below.

## Materials and Methods

(1) Cow sera: Cow sera was obtained from the Huainan Farm in Anhui Province, the Huaiyin Municipal Health and Epidemic Prevention Station in Jiangsu Province, and the Weigang Dairy Farm in Nanjing. (2) Purified horse anti-HBs: Horse anti-HBs-I and horse anti-HBs-II were provided by the No 127 Hospital and by the Military Medicine Research Institute of the Nanjing Military Region Logistics Department. The agar double diffusion titers were 1:32 and 1:8. (3) Purified HBs-Ag: This was provided by the Military Medical Research Institute of the Nanjing Military Region Logistics Department. It was purified in a Sephadex-G200 column following pepsin digestion. (4) Assay for HBV serological markers in dairy cow seas: HBsAg: Shanghai Medical Chemistry Institute reagents were used in the ELISA method; anti-HBs: the indirect hemagglutination method was employed using reagents we prepared ourselves. HBeAg and anti-HBe: the ELISA method was used with reagents from the Shanghai Medical Chemistry Institute; and anti-HBc: ELISA kits from the Military Academy of Medical Sciences and the Shanghai Medical and Chemical Institute. (5) Polymeric human sera albuminin receptor (PHSAR): ELISA method[7]. (6)  $^{32}\text{P}$ -HBV DNA spot hybrid assay: Kit from the Hepatic Disease Institute of Beijing Medical University. (7) Rapid immunoelectron microscope technique: Improved Meyrick method.[8] Use of horse HBs in reaction with the dairy cow sera to be tested. Examination using the JEM-1200 EX transmission electron microscope. (8) Agar double diffusion: HBsAg strongly positive serum tested by the ELISA method in diffusion with horse anti-HBs on a 1 percent agarose gel board.

## Results

1. Connection With Human HBV Sera. (1) Serum test results were negative for 35 dairy cow serum samples from the Weigang Dairy Farm and the Huaiyin Municipal Epidemic Prevention Station. Sixteen samples from the Huainan Farm tested positive for HBsAg and/or HBeAg (see Table 1). Assay results of cow sera showed six samples in which the immunoelectron microscope found HBV-like particles (see Table 2). (2) Agar double diffusion: the electron microscope found HBV-like particles in five of six samples of cow sera, and one to three precipitation lines appeared in horse anti-HBs. In each of cow serum numbers 11, 12, and 17-2 there was a line that was identical to the purified HBsAg line.

2. Immunoelectron Microscope Assay Results. For the 19 samples of cow sera for which HBV serological markers were negative, immunoelectron microscope assay results were negative. For the 16 samples of serum that showed positive for one or two different HBV markers, a single immunoelectron microscope testing found no abnormalities in 10. In six samples that were tested nine times, HBV-like particles were found between three and six times.

Table 1. Cow Sera HBsAg and HBeAg Assay Results\*

<u>Sample Number</u>	<u>HBsAg (P/N) **</u>	<u>HBeAg (P/N)</u>
11	4.5	4.5
12	6.4	4.7
13	4.7	<1.5
14	2.5	3.8
15	2.4	3.5
16	4.5	2.4
17-1	3.3	2.3
17-2 $\Delta$	5.2	4.5
18	3.5	4.5
19	3.5	5.0
20	5.2	2.2
21	6.6	2.2
22	3.7	<1.5
23	2.3	3.5
24	2.1	5.2
25	4.8	<1.5
26	4.0	3.5

\*Results shown in this table are from Huainan Farm cow sera. The cow sera HBsAg, and the HBeAg P/N for Weigang and Huaiyin were all less than 1.5.

\*\*Samples with a P/N of more than 2.1 were positive;  $\Delta$  denotes the second sample of sera taken 1 month later.

Table 2. Assay Results of Dairy Cow Serum Markers Showing Positive for HBV-Like Particles

<u>Specimen number</u>	<u>HBsAg (P/N)</u>	<u>HBeAg (P/N)</u>	<u>PHSAR (P/N)</u>	<u>Anti-HBs (titer)</u>	<u>Anti-HBc (suppression rate)*</u>	<u>Anti-HBe (suppression rate)*</u>
11	4.0	4.6	<1.5	<1:2	<10%	<10%
12	6.4	4.8	<1.5	<1:2	<10%	<10%
16	4.4	2.6	<1.5	<1:2	<10%	<10%
17-2	5.5	4.5	<1.5	1:512	<10%	<10%
21	6.3	2.3	<1.5	<1:2	<10%	<10%
22	3.5	1.2	<1.5	<1:2	<10%	<10%

\*Suppression rate of 50 percent or greater were positive

3.  $^{32}\text{P}$ -HBV DNA Hybrid Test. Results were all negative for six samples of cow sera in which the electron microscope had found HBV-like particles.

#### Discussion

Verification of the reliability of the discovery of HBV-like particles in cow sera may be found in the following several points: (1) Multiple use of the immunoelectron microscope technique (and two kinds of horse anti-HBs) on

seven serum samples from six dairy cows (the two samples from cow number 17 being personally taken by the author of this article) repeatedly found the particles. (2) ELISA assay of seven samples of cow sera showed positive reactions for HBsAg and/or HBeAg. (3) Agar double diffusion of horse anti-HBs may produce precipitation lines. (4) The horse anti-HBs (from two sources) that were used in the immunoelectron microscope technique were found negative for HBsAg and HBeAg after having been tested several times, and neither did immunoelectron microscope examination discover any HBV-like particles.

It is as yet difficult to speak with certainty about the nature of the HBV-like particles in the cow sera. Though extremely similar to human HBV in morphological structure, and though cow sera containing this kind of particles also contain human HBV HBsAg and/or HBeAg markers, and immunoelectron microscopic examination also uses anti-HBs in the preparation of immuno compounds; nevertheless, they may possibly be only a kind of virus that has a close antigenic relationship to human HBV, but is not actually human HBV. The reasons are as follows: (1) Results of spot hybridization with human  $^{32}\text{P}$ -HBV DNA were negative. (2) PHSAR was negative. (3) When double immunodiffusion was done on an agarose gel board, there were precipitation lines between milk sera containing the HBV-like particles and the horse anti-HBs. Only after 72 hours of diffusion were they faintly visible. The precipitation lines between the HBsAg positive patients' sera and the horse anti-HBs, however, showed up clearly within 6 to 12 hours. Only one of the precipitation lines formed by the positive cow sera fused with the precipitation line formed by the purified HBsAg.

Inasmuch as there is only a partial antigen relationship between the HBV-like particles in the cow sera and the human HBV, and since the HBs contained only a small amount of antibodies that were specific to the former, in doing the agar double diffusion, without dilution of the antibodies, no precipitation lines formed, but when the anti-HBs was diluted, precipitation lines appeared. Possibly this is related to the most appropriate ratio of antigens to antibodies, and it may also be a reason why the immunoelectron microscope technique cannot produce a positive result every time.

Judging from the present test situation, there may be definite regional distribution differences in the infection of dairy cows with these kinds of HBV-like particles in the same way as there is in the infection of ducks with duck hepatitis virus<sup>[9]</sup>. Of course, no HBV-like particles have as yet been found in cow sera from the two places in Jiangsu Province from which samples were taken. That the HBV serological markers were negative does not rule out the possibility that there are such viral infections in cow herds in these areas.

(This work received energetic assistance from leaders at the Huainan Farm, and from Comrade Zhang Xianli [1728 3759 4409] at the Huainan Institute of Agricultural Sciences. Comrade Wang Peilong [3769 1014 7893] of the Huaiyin Municipal Health and Epidemic Prevention Station in Jiangsu Province provided cow sera specimens. Cheng Baogeng [4453 1405 1649], director of the Electron Microscope Laboratory at Nanjing Medical Academy; Song Jizhi [1345

4949 1807], director of the Electron Microscope Laboratory of Nanjing Railroad Medical Academy; Professor Du Nianxing [2629 1819 5281] and Teacher Liu Shengjiang [0491 0524 3068] of the Veterinary Department at Nanjing Agricultural University provided guidance and verification of the immuno-electron microscope test results, for which deep appreciation is hereby expressed.)

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9432/6091

# Findings on Isolation, Purification of Venom Peptides

40081076a Beijing SHENGWUHUAXUE YU SHENGWUWULI JINZHAN [PROGRESS IN BIOCHEMISTRY AND BIOPHYSICS] in Chinese Vol 15 No 2, Apr 88 pp 127-130

[Article by Wei Shan [7614 3790] and Ren Yongzhong [0117 3057 1813], Biochemistry Teaching and Research Section, Chinese Medical University, Shenyang: "The Isolation and Purification of Bradykinin Potentiating Peptide (ABBR, BPP) From the Venom of Agkistrodon Blomhoffii Brevicaudus Stejneger in Jiangxi Province, China"]

[Text] Abstract: Ethanol extraction, and column chromatography and paper chromatography methods were used to isolate and purify three bradykinin potentiating peptide (BPP) components, namely nonapeptide, decapeptide, and hexadecapeptide, from ABBR venom of Jiangxi origin. These components had a bradykinin potentiating effect on the ileums of guinea pigs in vitro. The proline content of their peptide chains was very high. Structural characteristics were extremely similar to ABBR BPP from Japan and Jiangxi Province in China.

BPP contains 5 to 13 amino acid residue active short peptides. Numerous references have reported[1-4] that BPP has a very powerful inhibiting effect on angiotensin I invertase. BPP's ability to both inhibit the effect of kininase II and increase the effect of bradykinin, and its ability to inhibit angiotensin I invertase as well results in no generation within the body of blood pressure-increasing angiotensin II. It is an effective substance for lowering pressure. A simpler but effective substance similar to BPP has now been synthesized, namely 2-methyl 3-mercaptopropionyl proline[5], which is widely used in the clinical treatment of renal hypertension.

This article reports use of a fairly simple yet effective method of isolating and purifying three BPP components from Agkistrodon blomhoffii brevicaudus stejneger venom.

## Materials and Methods

Freeze dried BPP venom from Jiangxi was kindly provided by He Wenxue [6787 2429 1331].

The bradykinin (BK) was a product of the Sigma Company, USA.

Various types of Sephadex and SP-Sephadex C-25 were products of the Swedish Pharmacia Company.

Testing of the biological vitality of the bradykinin and the BPP was done using the He Zian [0149 1311 1344] method.[6]

Paper chromatography chlorine development method: The chromatography filter paper was sprayed for 6 hours in a 30°C constant temperature incubator, and the developer used was *n*-butyl alcohol, acetic acid, and water (3:1:1). When development was completed, the developer residue on the filter paper was blown dry, and the filter paper was suspended in a jar of chlorine for 10 minutes after which a starch-potassium iodide reagent was used to develop it.

Amino acid component analysis: The BPP chromatography spot was scissored out and put into a test tube where extraction in methanol was done for 12 hours. Evaporation removed the methanol. It was dissolved in 1 ml 5.07 mol/L of hydrochloric acid, and fusion sealed with fill nitrogen. It was hydrolyzed for 24 hours at 105-110°C, and assayed in a Hitachi Model 835 amino acid automatic analyzer. Results of the assay were figured using the Kato[7] calculation method to derive the gram molecular figures for the various amino acids.

#### Experiment Results

##### 1. Crude Extraction of Snake Venom Using Ethanol

Ten grams of dry frozen snake venom powder was dissolved in 1,000 ml of distilled water and boiled in a boiling water bath for 10 minutes. After cooling, 95 percent ethanol (at a rate of 500 ml per gram of crude venom) was added. The ethanol-venom suspension was filtered and the supernate was concentrated until dry in a rotary evaporator. To the compressed, dry powder was added anhydrous ethanol and three separate extractions made of 20 ml each time. The extracts were combined and concentrated til dry.

##### 2. Use of Column Chromatography To Isolate and Purify the BPP

The dry powder that had been extracted with ethanol described above was dissolved in 2 ml of a 0.02 mol/L  $\text{NH}_4\text{HCO}_3$  buffering solution which was directly added to a Sephadex G-15 chromatography column (1.7 x 170 cm). A 0.02 mol/L pH 8.0  $\text{NH}_4\text{HCO}_3$  buffering solution was used in balanced elution. See Figure 1. The activity peaks were combined and collected and diluted with an equal amount of distilled water. Formic acid was used to adjust the pH to about 2.5, and isolation was done in an SP-Sephadex C-25 chromatography column (11 x 30 cm). Then 0.01 mol/L of ammonium formate at a pH of 2.5 and 0.5 mol/L of ammonium formate at a pH of 6.2 were used in gradient elution (100 ml each). See Figure 2 for the chromatograph atlas. The peak activity portions were merged and concentrated, then added to the Sephadex G-10 column (1.0 x 110 cm) and desalinated using 0.1 mol/L of hydrochloric acid balanced elution at a pH of 1. (See Figure 3.) The

activity peaks were collected, and Nessler's reagent was used in a test to make sure they contained no  $\text{NH}_4^+$ . They were concentrated preparatory to being isolated through paper chromatography.

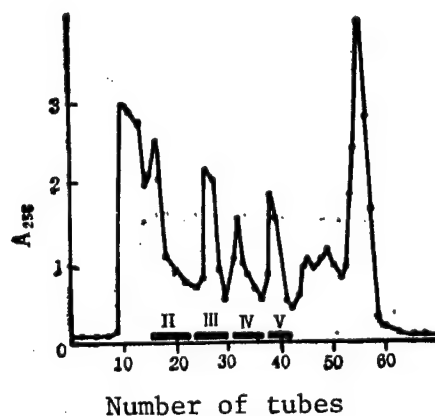


Figure 1. Isolation of Ethanol Extract in Sephadex G-15 Column. II, III, IV, and V are active components. Elution speed was 30 ml/hr, one tube being received every 6 minutes.

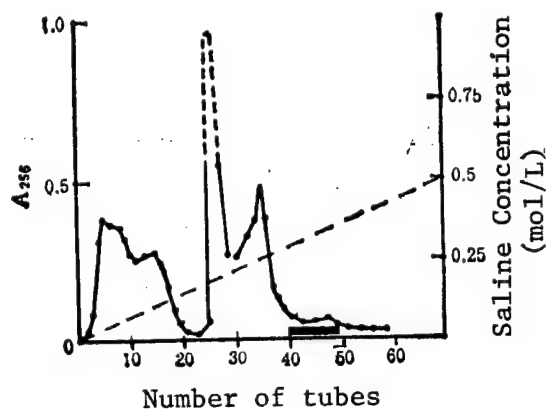


Figure 2. Isolation of BPP in an SP-Sephadex C-25 Column. Tubes 40 to 49 contain the active component. Elution flow speed was 30 ml/hr, one tube being received every 6 minutes.

### 3. Isolation of the BPP Extract in Paper Chromatography

The active portion was removed after concentration of the salt and purified in Xinhua filter paper chromatograph. For results, please see Figure 4 and Figure 5 [not reproduced]. Ninhydrin development produced the three bands A, B, C, and  $R_f$  with respective values of 0.49, 0.44, and 0.35. The chlorine developed band coincides with the ninhydrin developed B band. After biological evaluation, in an in vitro guinea pig ileum, the A, B, and C components were able to increase the contraction of the bradykinin as is shown in Figure 6. These are termed P-A, P-B, and P-C respectively.

Analysis of the amino acid components showed P-A to be a nonapeptide, P-B a decapeptide, and P-C a hexadecapeptide (see Table 1 for details).

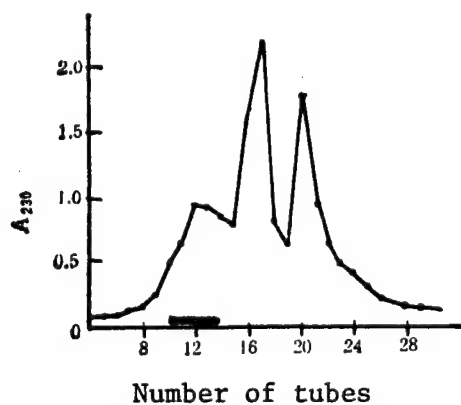


Figure 3. Isolation of BPP in Sephadex G-10 Column. Tubes 12 to 14 contain the active component. Elution flow speed was 3 ml/18 minutes, one tube being received every 18 minutes.

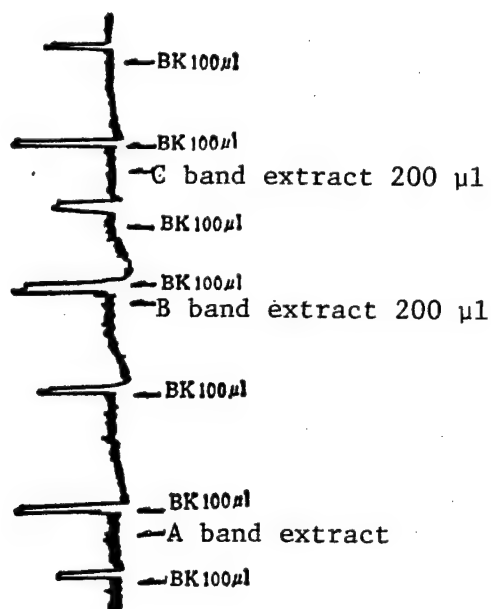


Figure 6. Biological Evaluation of Various Components After Paper Chromatography

A band extract 40  $\mu\text{g/ml}$   
 B band extract 50  $\mu\text{g/ml}$   
 C band extract 40  $\mu\text{g/ml}$



Table 1. Amino Acid Components of BPP From the Venom of *Agkistrodon blomhoffii* From Jiangxi Province in China, of *Agkistrodon halys* From Zhejiang Province in China, and of *Agkistrodon halys* From Japan

Amino acids	Jiangxi <i>Agkistrodon</i>			Zhejiang <i>Agkistrodon</i>	Japanese <i>Agkistrodon</i>				
	P-A	P-B	P-C		A	B	C	D	E
Lys			0.9(1)			1			1
Arg	0.9(1)	0.6(1)	1.5(2)	0.9(1)	1	1		1	
Glu	1.0	1.0	1.0	1.1(1)	1	1	1	1	1
Pro	3.3(4)	2.6(3)	5.6(6)	6.0	5	5	6	6	5
Gly	1.2(1)	1.4(1)	1.9(2)	1.9(2)	2	1	2	1	
Ile	0.9(1)	0.9(1)	1.4(1)	0.9(1)	1	1	1	1	
Leu						1	1	1	
Asp		0.9(1)	1.1(1)						1
Ser		0.6(1)							1
Val									1
Trp									1
His	0.8(1)	0.8(1)	1.9(2)						
Total	9	10	16	11	10	11	11	11	11

#### Discussion

In 1965, Ferreira<sup>[8]</sup> first discovered the BPP element in the venom of an American *Bothrops Jararaca* snake that was able to increase the action of bradykinin in vitro or in vivo, and then he went on to clarify the structure of nine different BPP factors<sup>[9,10]</sup>. Not long afterward, Kato<sup>[7,11,12]</sup> et al. also isolated five different BPP components from the Japanese *Agkistrodon halys blomhoffii*, and determined their structure. In China, He Zian<sup>[6]</sup> et al. at the Shanghai Biochemistry Institute purified a BPP component from a Zhejiang *Agkistrodon halys pallas* in 1981, and clarified its structure. Among the other snakes in which the BPP structure is known, the maximum number of peptides is 13, and the minimum is 5. Most have around six. Their structure has the following characteristics: They all have cyclic [sic] glutamic acid at the N end, and proline at the C end. The proline content of the peptide chain is very high and is frequently found in duplicate. We purified three different BPP components from a Zhejiang *Agkistrodon halys pallas*, namely P-A, P-B, and P-C. P-A had 9 peptides, P-B had 10, and P-C had 16. Table 1 shows P-A contains four prolines, P-B contains three prolines, and P-C contains six prolines. Each of these three peptide chains contains a glutamic acid. Despite differences between the amino acid component of the BPP in the Jiangxi *Agkistrodon halys pallas* and the makeup of BPP in other snakes, one similarity was a high proline content. It has been demonstrated<sup>[13]</sup> that B activity is related to the C end proline dipeptide. BPP is able to inhibit the activity of kininase II and angiotensin invertase I. (It is now believed that the two are the same enzyme.) Bradykinin contains two proline nanopeptides, and angiotensin I contains a proline's hexadecapeptides. The structure of BPP is similar to both. Whether BPP acts through bradykinin to inhibit the transformation of angiotensin I is an extraordinarily interesting topic. One can see

from Table 1 that one outstanding difference between the three different BPP components in the Zhejiang Agkistrodon halys pallas snake venom and the BPP components of the Japanese snake venom was that the P-A, P-B, and P-C contained histidine, but the BPP in the Zhejiang Agkistrodon venom and the Japanese Agkistrodon venom did not contain histidine.

Zhang Jianqiu of the Forest Soil Institute of the Chinese Academy of Sciences, and He Wenxue, Zhao Naicai [6392 6621 2088], Zhu Mingyan [2612 2494 2518], and Fu Shouting [0102 1343 1656] of the Chinese Medical University helped with this experiment, for which appreciation is expressed.

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# Dot Immunobinding Assays Using Nitrocellulose Membrane Substitute

40081076b Beijing SHENGWUHUAXUE YU SHENGWUWULI JINZHAN [PROGRESS IN BIOCHEMISTRY AND BIOPHYSICS] in Chinese Vol 15 No 2, Apr 88 pp 156-157

[Article by Jiang Zuojun [5592 0155 0689] and Shen Yiping [3088 0001 1627], Nanjing Academy of Medicine: "Dot Immunobinding Assay of Chinese Manufactured Mixed Cellulose Film"]

[Text] Abstract: A dot immunobinding assay was done using Chinese manufactured mixed cellulose film as a carrier in place of imported nitrocellulose membranes, and using Tween-20 as a blocking agent to take the place of expensive cattle serum albumin. The results show that the mixed cellulose film retains inherent advantages for dot immunobinding assay; it is inexpensive; and it is readily available. Tween-20 blocking agent showed no marked non-specific background coloring. These improvements help promote dot immunobinding assay techniques.

Dot immunobinding assay,[1] or Dot-ELISA,[2] or Antigen Spot Test (AST),[3] as it is alternatively known, has developed into a new technique for making immunological tests during the past several years. Up until now, dot immunobinding assays reported in both Chinese and foreign references have used nitrocellulose membranes (NC) as a carrier. Since extremely few factories in China produce NC, some being in the trial manufacture stage, and since imported NC is expensive and may not arrive on time after being ordered, the promotion of this new technique in China has been limited. We conducted dot immunobinding assays using Chinese manufactured mixed cellulose film as a carrier, obtaining fairly satisfactory results. The experiment is reported below.

## I. Materials and Methods

1. Mixed Cellulose Film (MC): Aperture 0.22  $\mu\text{m}$ , a product of the Shanghai Medical Industry Research Academy.

2. Paragonimiasis Westermani Metacercaria Antigen (M-PB-Ag): Prepared by this laboratory; concentration of 500  $\mu\text{g/ml}$ .

### 3. Blood Serum

(1) Two months after rat infected serum (ris) containing *Paragonimus westermani* was injected into the abdominal cavity of a pure line of Wistar rats to produce *Paragonimiasis westermani* metacercaria antigens (100 metacercaria per rat), serum was separated from blood taken by piercing the rats' hearts.

(2) *Paragonimiasis westermani* metacercaria antigen immune rabbit serum (MIRS). M-PB-Ag was injected into the lymph nodes of immune pure line New Zealand rabbits to obtain MIRS.[4]

(3) Both normal rabbit serum (NRS) and normal rat serum (NrS) were prepared by this laboratory.

4. Horse radish peroxidase labeled *Staphylococcus aureus* A protein (or A protein, for short), at a working concentration of 1:20 was a product of the Shanghai Biological Products Laboratory.

5. Substrate System. Prepared according to the method of Wang Jianyi [3769 1696 0001] et al.

### 6. Several Different Buffering Solutions

(1) pH 7.2, 0.01 mol/L of phosphate buffering solution (PBS)  
 $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$  3.87 g,  $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$  0.61 g, NaCl 40.83 g, plus distilled water to make 1,500 ml.

(2) pH 7.4 PBS-Tween 20  $\text{KH}_2\text{PO}_4$  0.544 g,  $\text{Na}_2\text{HPO}_4$  2.27 g, NaCl 6.72 g, Tween 20 0.5 ml, plus distilled water to make 1,000 ml.

(3) Trishydroxymethylaminomethane (TBS, pH 7.5) 1 mol/L Tris 2.8 ml, 1 mol/L HCl 17.0 ml, NaCl 7.5 g,  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$  0.1 g,  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  0.02 g, plus distilled water to make 1,000 ml.

### 7. Dot Immunobinding Assay Procedure

(1) The MC was cut to the required dimensions and marked very lightly with dots, each dot being the same distance apart as the holes on the enzyme labeled reaction board, or somewhat more.

(2) The MC was put into the PBS for 30 minutes, and blotted with filter paper after removal.

(3) A specially made capillary pipette was used to dot the M-PB-Ag, each dot consisting of approximately 2  $\mu\text{l}$  with a protein content of 1  $\mu\text{g}$ .

(4) The MC was put in a refrigerator at 4°C for 5 minutes, and then washed with TBS for 5 minutes.

- (5) The blocking agent PBS-Tween 20 was used to incubate the MC for 15 minutes at room temperature while being gently vibrated. After removal, it was blotted with filter paper.
- (6) The MC was placed in a culturing dish containing water, the MC being cushioned on a piece of bubble plastic. The serum to be tested, control serum and 2  $\mu$ l of PBS was added to separate dots, and the culturing dish was placed in a refrigerator at 4°C for 15 minutes.
- (7) The MC was washed in PBS four times, 3 minutes each time, while being lightly vibrated. It was blotted with filter paper after removal.
- (8) To each dot was added 2  $\mu$ l of protein solution and it was left at room temperature for 40 minutes.
- (9) The MC was washed as in step 7.
- (10) To each dot was added 50  $\mu$ l of the substrate solution. One minute later, the MC was washed with distilled water to halt the reaction. After blotting the MC with filter paper, it may either be developed or kept in a dark place.

## II. Results and Discussion

Results from the dot immunobinding assay showed a positive reaction (brown dots) for the MIRS serum and the ris, and the control serum NRS and the NrS both showed negative. Slight background interference was apparent on two dots in the control PBS, possibly because blocking was uneven causing non-specific absorption by the MC of a small amount of A protein. In subsequent assays, we extended the PBS-Tween 20 blocking time to 30 minutes and avoided the effects of gas bubbles on the MC (the Tween 20 is prone to producing gas bubbles), eliminating the aforementioned background interference.

In this assay, only 1  $\mu$ g of antigen was used on each dot, and 2  $\mu$ l of both the blood serum and A protein were used. PBS-Tween 20 was used as a blocking solution instead of expensive cattle serum albumin or calf serum. The entire assay was completed within 3 hours. It should be noted that tweezers should be used throughout the assay process, and when scissoring the MC, porous plastic gloves should be used to avoid having the hands come in direct contact with the MC.

Professor Zhao Weixian [6392 1983 0341] of the Nanjing Medical Academy helped check this article, for which appreciation is hereby expressed.

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# Bioassay of Mutagenicity of Thallium Carbonate

40081079 Beijing HUANJING KEXUE [ENVIRONMENTAL SCIENCE] in Chinese Vol 9  
No 2, Apr 88 pp 29-32

[Article by Zhang Dongsheng [1728 0392 3932], Institute of Environmental Hygiene and Hygienic Engineering, Chinese Academy of Preventive Medicine]

[Text] Thallium and its compounds are one of the highly toxic and cumulative toxic substances. Because of thallium contamination and inappropriate use of the chemicals, there are incidents of poisoning, even death. Due to environmental contamination by thallium, nearly 200 people have been chronically poisoned in some localities in Guizhou Province. The discharges from thermal electric power stations and from metallurgical refineries for lead or zinc, etc. are the most important sources of contamination. In recent years, it has been found that thallium compounds can induce abnormal embryonic development in chickens, and cause single strand DNA breakage. Thus, the harmful effect of a long-term contact with a low amount of thallium in the environment to human health, and its probable carcinogenicity have been drawing the attention of people in related fields in China as well as abroad.

This article reports the result of tests on the mutagenicity of thallium carbonate using four simple assay techniques.

## I. Materials and Methods

### 1. Chemicals

Thallium carbonate ( $Tl_2CO_3$ , analytical pure), obtained from Beijing Chemical Engineering Plant, is readily dissolved in water. Mitomycin (MMC, injection fluid) produced in Japan was used. Ethylmethane sulfonate (EMS, chemically pure) was the product of Beijing Chemical Engineering Plant.

### 2. Bacillus subtilis Recombination Repair Test--Spore Method

*B. subtilis* strains  $H_{17}^+$  ( $R_{ec}^+$ ), a recombination repair positive strain, and  $M_{45}^-$  ( $R_{ec}^-$ ), a recombination repair negative strain, were supplied by Wang Yuzhi of Shenyang Worker's Health and Occupational Disease Laboratory. The test was carried out according to the technique described<sup>1</sup>). A

suspension of spores (concentration was adjusted uniformly to  $5 \times 10^7/\text{ml}$ ) was prepared respectively for strain  $H_{17}^+$  and strain  $M_{45}^-$ . 0.1 ml was taken from each suspension and added to 12 ml of nutrient agar (product of Shenyang) kept at  $45^\circ\text{C}$ , which after uniform mixing, was poured into a petri dish. After the agar solidified, filter papers (8 mm in diameter) soaked with 20  $\mu\text{l}$  chemical with varied concentrations were placed on top of the agar. After incubation at  $37^\circ\text{C}$  for 20 hours, the radius of the germination inhibition circle was measured, and the result was examined using Suter's<sup>2)</sup> criteria, i.e., when the difference of the inhibition length between the two strains is  $\geq 6$  mm, it is ++,  $< 6$  and  $\geq 3$  mm, it is +,  $< 3$  and  $\geq 2$  mm, it is  $\pm$ , and  $< 2$  mm, it is -.

### 3. Chinese Hamster Ovary Cells (CHO) Sister Chromosome Exchange (SCE) and Chromosome Aberration (CA) Tests

CHO cells were supplied by Qin Yuhui of the Environmental Health Examination Station, Chinese Academy of Preventive Medicine. The tests were carried out basically according to the method described<sup>3)</sup>.  $1 \times 10^6$  cells were inoculated into minimal essential medium (MEM) containing 10 percent fetal bovine serum (Tianjin product), and after 24 hours incubation, the medium was replaced with an MEM containing 5-bromodeoxyuracil (BrdU, final concentration, 20  $\mu\text{mol}$ ) and 2.5 percent fetal bovine serum. Simultaneously, a certain concentration of thallium carbonate was added, and the mixture was allowed to react in the dark for 24 hours. The test material was removed, washed three times with Hank's solution, and added into the MEM containing BrdU (20  $\mu\text{mol}$ ) and 10 percent fetal bovine serum. Incubation was continued for 9 hours and the cells were harvested. Four hours before the harvesting, colchicine (final concentration, 1  $\mu\text{g}/\text{ml}$ ) was added. The cells were as usual fixed and thin sectioned, and the specimen for chromosomal analyses was stained directly with Giemsa staining solution for examination of the rate of CA occurrence per 100 cells. For the measurement of SCE frequency, the specimen was differentially stained and after calculating SCE in 50 cells, the average value was computed.

### 4. Chinese Hamster Pulmonary Fibrous Cell (V79) Hypoxanthine Guanine Phosphate Ribonucleic Acid Transferase (HGPRT) Gene Positive Mutation Test

V79 cells were obtained from Cheng Shujun of the Institute of Oncology of the Chinese Academy of Medical Sciences. The cells were regularly grown in MEM containing 20  $\mu\text{mol}$  Hepes buffer solution, complemented with 10 percent fetal bovine serum (GIBCO). Experiments were carried out according to the methods described in literature<sup>4-5)</sup> (shown in Figure 1). During the reaction with chemicals, the cells were incubated in MEM with 2.5 percent fetal bovine serum. When the expression time was 6 days [i.e., the difference in time from the reaction with  $\text{Ti}_2\text{CO}_3$  to the addition of 6-thioguanine (6-TG)], at each dose the total number of  $1.2 \times 10^6$  cells was inoculated for the measurement of mutation rate, and at the same time, about 500 cells/petri dish were inoculated for the measurement of viable cells. Mutation rate was calculated from the actual viable cell. During the experiment, the cell density prior to the re-inoculation of cells was controlled at below  $8 \times 10^4$  cells/ $\text{cm}^2$  ( $\text{cm}^2$  means the bottom area of a flask or a petri dish), and the cell density during selection was about  $5 \times 10^3$  cells/ $\text{cm}^2$ .



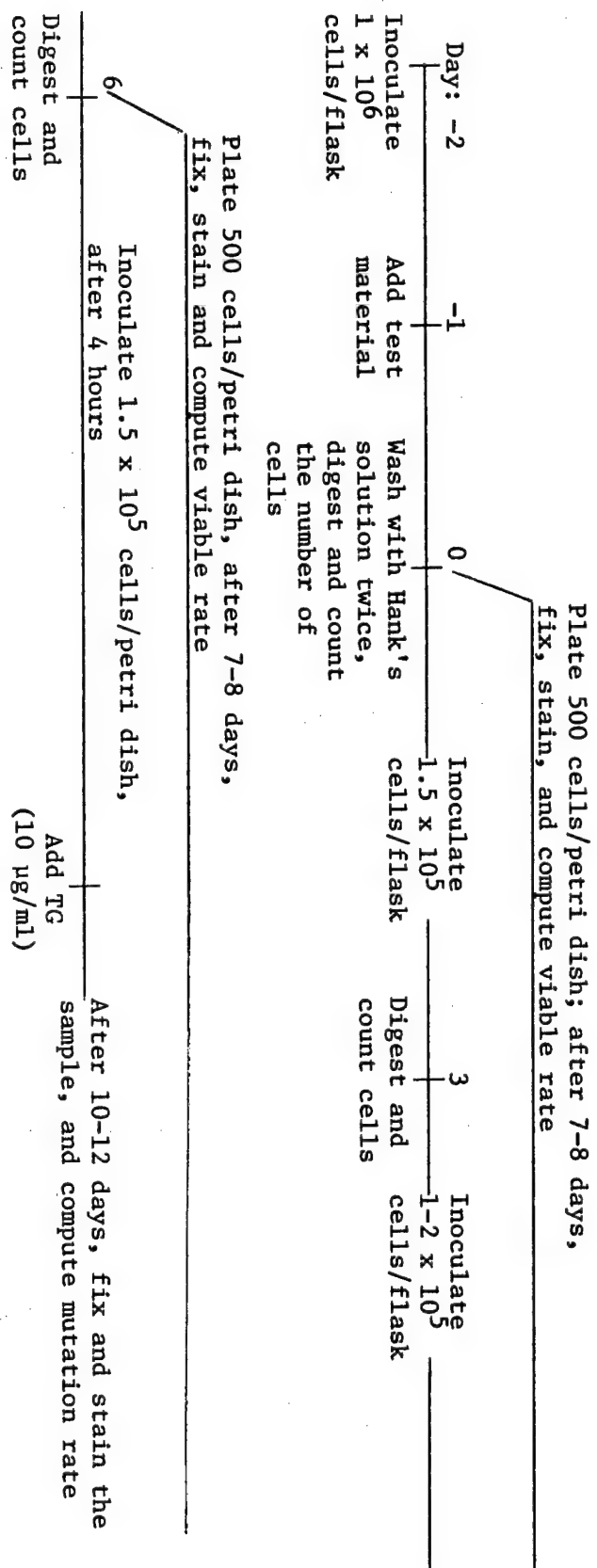


Figure 1. Experimental Procedure for  $Tl_2CO_3$  Induced  $TG^r$  Mutation of V79 Cell

## II. Results

1. The growth inhibition of the two strains of spore-germinated bacteria by various  $\text{Tl}_2\text{CO}_3$  concentrations is listed in Table 1, which shows the different inhibition effect on the two strains by  $\text{Tl}_2\text{CO}_3$ . The mutagenic activity of  $\text{Tl}_2\text{CO}_3$  increased as the dose increased; the difference in the inhibition effect against the two strains also became greater. The mutagenic activity was at the maximum when the dose was 200  $\mu\text{g}/\text{filter}$ .

Table 1. Results of Spore Recombination Experiments With  $\text{Tl}_2\text{CO}_3$

Chemical	Dose ( $\mu\text{g}/\text{filter}$ )	Inhibition radius (mm) <sup>1)</sup>		Differ- ence	Activity
		$\text{H17}^+$	$\text{M45}^-$		
Distilled water	20 $\mu\text{l}$	0	0	0	-
MMC (positive control)	0.02	1.1	7.9	6.8	++
	0.20	4.5	13.5	9.0	++
	1.00	11.7	19.1	7.4	++
$\text{Tl}_2\text{CO}_3$	25	1.4	2.9	1.5	-
	50	6.5	11.0	4.5	+
	100	12.8	17.1	4.3	+
	200	13.6	19.6	6.0	++
	300	14.6	19.0	4.4	+

1) Average value of three experimental results.

2. The experimental results on the SCE and CA induced in CHO cells by  $\text{Tl}_2\text{CO}_3$  are shown in Tables 2 and 3. The results show that not only  $\text{Tl}_2\text{CO}_3$  increased induction of SCE and CA in CHO cells, but there was a definite relationship between dose and reaction. When the dose was at 10  $\mu\text{g}/\text{ml}$ , SCE clearly increased ( $p < 0.05$ ); at 20  $\mu\text{g}/\text{ml}$ , the incidence of SCE was at the highest with 9.06 SCE/cell, which showed  $p < 0.01$  compared to control. Under the same conditions, only when the dose reached 20  $\mu\text{g}/\text{ml}$ , there was a statistically significant increase in the incidence of CA. As the dose increased, the rate of CA occurrence appeared to show a trend to increase.

3. The result of  $\text{Tl}_2\text{CO}_3$  to induce HGPRT gene positive mutation in V79 cells is listed in Table 4, from which it can be seen that  $\text{Tl}_2\text{CO}_3$  can induce HGPRT gene positive mutation in V79 cells, producing mutants resistant to TG ( $\text{TG}^r$ ). Such mutagenicity of  $\text{Tl}_2\text{CO}_3$  showed a better dose-reaction relationship. When the dose was 5  $\mu\text{g}/\text{ml}$ , the mutagenic activity began to increase; the maximum was 1.21.4 mutants/ $10^6$  viable cells.

## III. Discussion and Conclusion

Bowen<sup>6)</sup> pointed out that the pollution potential of thallium is great just like other metals. Thallium is a harmful pollutant of the environment. In the environment, thallium exists mainly in the form of soluble chemicals such

Table 2. SCE Incidence Rate in CHO Cells Induced by Different Doses of  $Tl_2CO_3$

<u>Chemical</u>	<u>Dose (<math>\mu g/ml</math>)</u>	<u>SCE/cell (mean <math>\pm</math> standard error)</u>
Distilled water	0	$7.26 \pm 2.72$
$Tl_2CO_3$	5	$7.83 \pm 2.99$
	10	$8.67 \pm 3.31^*$
	15	$8.51 \pm 3.12^*$
	20	$9.06 \pm 2.92^*$
	80 $\Delta$	Toxic
EMS	10	$13.88 \pm 4.01^*$

$\Delta$  is the result of an experiment, the rest are averages of three experimental results.

\* shows a significant difference by t-test.

Table 3. Dose-Reaction Correlation of CA Induced in CHO Cells by  $Tl_2CO_3$

<u>Chemical</u>	<u>Dose (<math>\mu g/ml</math>)</u>	<u>Rate of aberration (%)</u>	<u>P value**</u>
Distilled water	0	8.0	
$Tl_2CO_3$	5	11.0	$>0.05$
	10	15.0	$>0.05$
	15	17.0	$>0.05$
	20	19.3	$<0.05$
	40*	21.0	$<0.01$
	80*	25.0	$<0.01$
EMS	10	20.7	$<0.05$

\*The result of one experiment, the rest are average values of two experimental results.

\*\* $\chi^2$  test.

Table 4. Mutation Rate of  $TG^r$  V79 Cells Induced by Different Doses of  $Tl_2CO_3$

<u>Chemical</u>	<u>Dose (<math>\mu g/ml</math>)</u>	<u>Mutant cells/<math>10^6</math> viable cells</u>
Distilled water	0	1.8
$Tl_2CO_3$	5	34.3*
	20	69.4*
	80	121.4*
EMS	60	415.8*

\*Poison distribution test,  $p < 0.01$ ; the above are average values of two experimental results.

as thallium oxide and thallium sulfides, and therefore, we chose relatively easily soluble  $\text{Tl}_2\text{CO}_3$  as a representative thallium compound for the study on its mutagenicity. This characteristic is consistent with that of thallium compounds in the environment; which is an important and necessary point.

This study revealed that there is a positive correlation between the mutagenicity and the carcinogenesis of a metal compound. Many now depend on the mutagenicity of a chemical compound to determine a compound's potential carcinogenicity. Brusick<sup>7)</sup> pointed out that there are many mechanisms of genetic damage, but there is no single test that can examine all mechanisms. Also, because of the possible appearance of "false-positive" and "false-negative" results, it is not sufficient to explain a chemical's genetic harmful effect when mutagenic effect is obtained in a single test. Based on the basic principle for the selection of experimental system, we examined the mutagenicity of  $\text{Tl}_2\text{CO}_3$  using the four methods described above.

The B. subtilis recombination repair test measures DNA damage by examining bacterial death or growth inhibition to deduce whether or not a sample is a mutagen. It is one of the most sensitive test methods for testing metal mutagen. The inhibition effect of  $\text{Tl}_2\text{CO}_3$  against the recombination repair positive strain ( $\text{H}_{17}^+$ ) and the recombination repair negative strain ( $\text{M}_{45}^-$ ) is significantly different. Also, there appears to be a definite dose-reaction correlation, indicating that  $\text{Tl}_2\text{CO}_3$  seems to be a DNA damaging agent, possibly a mutagen.

SCE and CA are two results of cell genetics caused by mutagenic activity. Koller<sup>8)</sup> suggested that breakage is the most frequently observed abnormality in the chromosome of tumor cells. Many chemicals, such as cadmium and chromium, that induce CA have been shown to induce tumor formation. Therefore, this type of damage such as CA may be one of common mechanisms in the majority of mutagenic activity.  $\text{Tl}_2\text{CO}_3$  can directly increase the rate of CA induction in CHO cells; furthermore, there appeared a definite dose-reaction correlation, indicating the possibility that the compound may be carcinogenic. Even though the molecular mechanism of SCE and its biological consequences are still unknown, there is a close relationship between SCE and CA; furthermore, there appears to be a correlation to gene mutation. Thus, test for SCE can reflect the chemical's partial action to the genetic material.  $\text{Tl}_2\text{CO}_3$  can induce a significantly increased incidence of SCE in CHO cells, and show a dose-reaction effect, suggesting that  $\text{Tl}_2\text{CO}_3$  damages cell's DNA and that it may be a mutagenic carcinogen<sup>9)</sup>. Our results also indicate that the sensitivity of  $\text{Tl}_2\text{CO}_3$  to induce SCE in CHO cells is higher than its induction of CA, and there is a good consistency between the two.

Many hypotheses on carcinogenicity assume that carcinogenesis of a normal cell must go through the stage of mutation. It is now shown that many carcinogens are also mutagens. In the experiment with V79 cell mutation test system,  $\text{Tl}_2\text{CO}_3$  clearly induced TGR mutant V79 cell at a significantly higher rate than that in control; and also showed a good dose-reaction

correlation. This indicates that  $Tl_2CO_3$  can cause mutation in the HGPRT gene, suggesting it is a direct mutagen. Bradley, et al.<sup>10</sup> think that the basic DNA component and its repair function of V79 cells can be regarded as essentially similar to those of man, that is to say, the result obtained with V79 cells is applicable to humans. Thus the possibility that a long-term contact with a low dose of thallium in the environment may cause tumor induction should be deemed important.

Our results are basically consistent with those reported by other investigators. Zhasukhina reported that  $Tl_2CO_3$  can induce single strand DNA breakage in fibrous cells of rat and mouse, and showed positive results in lethal tests on rats. Thallium compounds can also induce deformation of chick embryos.

It is known that metal cations can bind proteins, purines, and phosphate ions. It is possible that the binding of metal ions to bases might increase the sensitivity of the base removal or breakage action of unknown nucleases, resulting in causing a mutation during the repair process. The experimental data suggest that the nucleus contains clearly a higher amount of thallium than other cell components (except cytoplasm), and that thallium has a great affinity to macromolecules of the cell. This explains that nucleus contains a high concentration of thallium and that it can interact with DNA. However, the mechanism through which thallium induces DNA damages, SCE, CA, and gene mutation remains to be unraveled. In our experimental system,  $Tl_2CO_3$  showed a definite mutagenicity, suggesting that  $Tl_2CO_3$  may be a genetically poisonous carcinogen. This type of result is the first of its kind reported in China. This result can contribute to the scientific bases for the determination of an environmental health criterion for thallium.

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Computer Expert Analyzes Developmental Strategy for Computer Industry

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[Article by Chen Liwei [7115 0500 3634]: "Developmental Strategy for the  
Computer Industry in Light of the Greater International Scene"]

[Text] Editor's note: Not long ago, the Central Committee and the State Council proposed a development strategy for the coastal areas of China. They said that the Chinese national economy must grasp opportunities, face challenges, and participate in the greater international scene. How is our computer industry to respond to this? What is its development strategy? Where is the initiative to be made? After careful thought, the famous Chinese computer expert, Chen Liwei, has analyzed and explored these questions from an overall view of our national economy and has offered ways to deal with the problems.

We hope as well that our many readers will express their own views on this problem. We will continue to publish articles of this nature so that we might promote the healthy development of the computer industry in China.

Over the past few years, China's computer industry has made happy progress under the guidance of the correct policy of "concentrating on applications to stimulate growth." The output value of 1987 reached 2 billion yuan, a 46 percent growth over the previous year, and four times that of 1978. But we have never been able to satisfy the demands of building the national economy in the area of product variety, and have had to rely on imports. The value of imports for computer products in 1987 was 416 million US dollars, greatly overshadowing the export value of 45 million US dollars.

The computer industry is a strategic industry that requires a small investment, sees quick results, has high increases in value, and conserves resources, and it has a definite foundation in China. Because computer applications have a determining function on the growth of the national economy and since China is a large country, we must facilitate its growth as well as build an independent autonomous computer industrial system before we can get out from under our dependence upon foreign countries. However, this is simply a long-range goal. All we can do as our national

economy grows is to attain these goals gradually and in a piecemeal manner. What we wish to explore at this moment, at this current stage, is what will be the strategy of growth for our computer industry? Where will be our window of opportunity?

To independently research the problems of the computer industry itself could not result in a correct answer. We must begin from an overall view of our national economy and analyze the tasks that must be taken up by the computer industry before we will be able to seek out a strategy of growth for the computer industry. In other words, it can only grow and mature as it supports the development of the national economy, and we must not merely study what is necessary for that, but also what is possible.

In the situation we now find ourselves, where we have opened up to the outside, the national economy of China can only be one portion of the global economy. That is manifested primarily in import-export trade, that is, the greater international scene. Therefore, this paper will begin with an exploration of relations between the national economy and the greater international scene.

1. The generation of foreign exchange is a premise of rapid growth for our national economy.

China is currently involved in an enormous economic reconstruction. Because existing equipment in our enterprises is obsolete and our technology is behind the times, we are in urgent need of technological transformation and of the import of advanced machines and equipment. What is more, because we are lacking in natural resources and because our materials industries are not current, part of the materials needed for production must be imported. Importing those two items requires the support of a great deal of foreign exchange each year. Therefore, the amount of foreign exchange that is exported has become a restricting factor for our national economic reconstruction. Only by hastening the generation of foreign exchange through exports can we quicken the growth of our national economy.

Looking back on the development of world economies, examples where export generation of foreign exchange fueled an economic upswing can be found everywhere. For example, England of the 17th Century, the United States, Canada, Australia, and New Zealand of the 19th Century, and Japan and West Germany of the post Second World War, as well as the recent "four little tigers" [Hong Kong, South Korea, Singapore, and Taiwan].

Therefore, the generation of foreign exchange through exports must be a focus for efforts throughout our national economy.

2. Giving proper place to the value of leading with exports.

Economic principles for developing nations that are related to foreign trade include two choices: replace imports or lead the way with exports.



Without doubt, replacing imports conserves foreign exchange, and the important measures by which to win independence and autonomy are very attractive. But these require the support of large amounts of foreign exchange, and required foreign exchange grows with the depth and breadth of replacement. If a single import replacement is universally used as part of government policy, the burden for foreign exchange is certain to be increased. It is only when a strong export capability has been achieved that we can selectively and progressively take the step. If products are to be sold domestically, this will require domestic markets to reach a considerable scale before they will suffice. We might even say that replacements for imports must have exports leading the way, for doing so is for benefit of expanding imports.

For example, during the 1950's the "four little dragons" (excluding Hong Kong) all adopted the policy of replacing imports, but their economic development faltered and they got into serious difficulty. During the 1960's, one after the other they adopted the policy of letting exports be the guide. For more than 20 years, because of their abundant foreign exchange they were able to import those products needed domestically. The value of imports in South Korea increased 200 times, that of Taiwan Province 40 times, and that of Singapore 17 times; economic growth has been rapid, and they have now risen from being developing nations to being "rising new industrial nations/regions." Recent signs have shown that because they have developed greater export capacities, South Korea and Taiwan Province are now adjusting their policies, proposing a replacement for imports under the premise of exports having led the way, and they are also raising the proportion of internal needs.

Because our nation is so large, our population so great, and our situation so complex, we cannot simply adopt policies that treat everything the same way. Look at regions, for example. There can be all different kinds. Look at the manufacturing industries. They can be widely varied. Enterprises ought to adapt to changing conditions. As far as timing is concerned, that should be constantly adjusted. But looking at our country as a whole, if we are to hasten the growth of the national economy and speed up the generation of foreign exchange with exports, then in the near term it would seem that we should adopt a governing policy that "integrates taking exports as the guide with replacing imports, while giving the guiding role of exports the primary position." In this way we will first develop a greater capacity for generating foreign exchange through exports.

The computer industry in China has in recent years carried out a policy of replacing imports. Because computer applications here are still at their first stage, the domestic market is quite small. In addition, foreign exchange is insufficient and it has been difficult to support an entry by the computer industry into the greater international scene, so we have not been able to satisfy the demands from the growth of our national economy. Experience has shown that we must fight our way into international or we have no hope for growth.

We can refer to the experience of the "four little dragons." The development of their computer industries began in the early 1980's. Because they adhered to the policy of letting exports be the guide, were oriented toward the international markets, and had come to grips with the good opportunity whereby microcomputers had begun to be popular in international markets, in only a few years time they have achieved a remarkable growth. Look at Taiwan Province. The value of exports in 1986 reached 2.06 billion US dollars, and volumes for personal computers alone were more than one million units. At the same time, the value of their computer imports was at only 550 million US dollars, 27 percent of the value of exports.

3. This is a good time at which to speed up the generation of foreign exchange through exports.

To bring down costs, during the 1960's and 70's, labor-intensive manufacturing internationally shifted from the developed nations to Southeast Asia, and world economic structures went through two major adjustments. The beneficiaries were the "four little dragons." We lost our opportunity.

Industrially developed nations have experienced a trend toward "hollowness." At present, one-fifth of the American manufacturing industry is manufacturing outside its own country. It is estimated that in the next few years, all developed nations will have reached this point.

World economic structures are currently undergoing a third major adjustment. The yen is rising in value. The Japanese economy is changing from one that is externally oriented into one that is looking inward. This will not only free up some world markets, but will also open up their domestic markets.

At the same time, Japanese capital is being invested abroad, and this is steadily increasing. Investment is growing most rapidly in the "four little dragons" and in Southeast Asia. There are signs that the proportions of investment in cheap labor developing countries (such as Thailand, Malaysia, and China) are on the rise.

Japanese enterprises have quickened their steps toward "internationalization" (building factories and manufacturing abroad).

The "four little dragons" are deficient in labor forces, and the costs of labor are getting higher and higher. They are beginning to shift labor intensive products toward the developing nations and are slowly climbing from the ranks of the industrial to technological and knowledge-intensive growth.

Summing up what I have just said, this is a good opportunity for China to develop enterprises that are oriented outside China, and for us to speed up our generation of foreign exchange through exports. What China has to offer are:

## Political Stability;

Abundant labor resources: each year our labor force grows by more than 10 million through growth and the turning away from farming;

Wage levels are low, approximately one-fifth that of Thailand and one-tenth that of South Korea;

We have all kinds of light and heavy industries, and they have a considerable scale and basis;

Our scientific and technical strength is richer, and greatly exceeds that of the "four little dragons" or other developing nations/regions.

4. We are currently faced with fierce international competition.

Faced with the major adjustment being made in the world economic situation at present, developing countries (Thailand, Malaysia, the Philippines, Indonesia, etc.) are working hard to improve their investment environments, to attract external investment, to develop labor-intensive products, to set up externally-oriented enterprises, and to complete the process of transforming from "replacing imports" to "letting exports be the guide" as they strive to enter the ranks of the "rising new industrialized nations."

Thailand, for example, has a stable government, and wages are only one-fifteenth those of Japan and one-quarter those of Taiwan. For the past 20 years, their economy has grown steadily and is at an annual growth rate of 7 percent. To attract foreign investment, in 1977 they set up a "National Committee to Encourage Investment" that is directly affiliated with the office of the prime minister. It is chaired by the prime minister himself, and has publicly passed laws that encouraged foreign investment. It has been praised as "the nation in Southeast Asia with the most favorable investment environment," and has consequently attracted much foreign investment. In 1987 alone, the total value of direct investment projects approved for foreign firms reached 2.549 billion US dollars (it was 2.24 billion US in China for the same period).

The primary investment directions for developed nations are just now shifting from developing nations to developed nations, and the impetus for investment is changing from a reduction in costs to overcoming trade barriers and getting market share.

As a part of manufacturing costs, labor has dropped from the previous 30 percent to less than 10 percent.

Developed nations are now selectively transforming the production technologies of certain labor-intensive products, and when they attain production automation this will not shift again outside their countries.

Summing up what has just been said, current international trends are such that on the one hand, there are excellent opportunities for China to attract foreign investment, to produce labor intensive products, and to generate foreign exchange through exports. However, on the other hand, competition is fierce. Also, time is already quite critical, and it is estimated by some economists that at the most there are only about 10 more years in which we can rely upon cheap labor to attract foreign investment and to expand exports. If we are not careful, we will lose another opportunity. Time has presented us with a grim challenge.

5. Formulate a strategic goal for generation of foreign exchange by exports. As an aid to undertaking a substantial inquiry, it is necessary to formulate a strategic goal for the generation of foreign exchange through exports.

Export conditions are complex for each country in the world and it is difficult to come up with a good model for reference.

But we have discovered that there are countries that have an equal economic level of growth and where the population sizes are not terribly different, but where the per capita value of exports has an inverse relation to population, or in other words, the gross value of exports has no relation to population. For example, among West Germany, Japan, and the United States the levels of economic growth are comparable and their population ratio is 1:2:4, respectively. The proportion of per capita value of exports is more or less 4:2:1. Or look at South Korea, Taiwan Province, and Hong Kong, whose population differ by a factor of 8, but whose export values are all at about 50 billion US dollars.

In addition, during the current economic upswing in which the "four little dragons" find themselves, when comparing the gross value of their exports with GNP, the more developed nations are higher. For developed nations like the United States and Japan, this proportion is about from 5 to 10 percent, while it is 35 percent for South Korea and 50 percent for Taiwan.

Therefore, as we determine the gross value for China's exports, we should not do as with GNP and look solely at population, for that can be only a reference. It would appear that we can use the level of exports for developed nations during the late 1970's and early 1980's as a reference, and that was between 150 and 200 billion US dollars.

Let us provisionally select 200 billion US dollars as the strategic goal for export values in China at the end of this century. If at that time our GNP is 800 billion US dollars, then the gross value of exports would be 25 percent of GNP (it is about 16 at present). This is certainly not considered high. Beginning with the gross export value of 39.5 billion US in 1987, to reach 200 billion by the end of this century would mean an average rate of growth at 14.35 percent (the real growth rate for 1987 was 27.8 percent). The value of exports in Japan rose from 6.7 billion US dollars in 1964 to 174 billion in 1985, for an average annual growth rate of 16.8 percent. That for South Korea grew from 10 billion US dollars in 1977 to 46 billion in 1987, for an annual growth rate of 16.5 percent.

To help with comparisons, we can take current exports of our coastal region as a base. The population is 200 million, so the per capita export value is 1,000 US dollars, comparable to that of the present-day United States.

We might imagine that we can use the coastal region as a springboard into the greater international scene, and that the interior regions and the coastal regions together constitute the greater domestic scene.

#### 6. Adjusting export commodity structures.

The problem of the structure of export commodities is a major problem of strategy. It must be continually adjusted and optimized in accordance with the particular situations in this country and internationally.

Primary products and finished products: in international markets, the competition among primary products is intense and prices continue to drop. Especially for a country such as ours, where the population is great and natural resources are deficient, the proportion of primary products among exports should be gradually decreased. In 1986 this had been reduced from the 50.5 percent of 1985 to 36.2 percent. The value of exports has not changed, and is about 10 billion US dollars. If by the end of this century that amount does not change, the proportion of primary products among gross export values will have dropped from the 36.2 percent of 1986 to 5 percent.

In this way, the proportion for industrial finished products among gross values for exports will rise from the 63.8 percent of 1986 (17.624 billion US dollars) to 95 percent. The gross export values will grow to 190 billion at an average growth rate of 18.5 percent (the actual rate of growth for 1986 was 72 percent).

Electromechanical products: in international markets, competition is very intense for light industrial products and the growth rate of those markets has been quite slow, and they are as well the targets for protectionist sentiments. For these reason, as far as the export of light industrial products is concerned, even though we will continue to strive to open these markets up, we should not make too many demands on the extent of this expansion. We should work hard to develop the export of electromechanical products. The export of electromechanical products throughout the world is at about one-third the gross value of exports, but there is room for more. The export of electromechanical products by developed nations is above 50 percent of the gross value of exports, and that can even be 70-80 percent.

In 1987, the value of electromechanical product exports was 3.854 billion US dollars, a growth of 55 percent over the previous year, and 9.6 percent of gross export values. We may provide for the value of electromechanical exports in China to reach 70 percent of gross export values by the end of this century, that is, 140 billion US dollars, 73.7 percent of the value of finished product exports, and thus an average annual growth rate of 31.8 percent.

Electronic products: aside from household appliances, electronic products belong to the high-technology category, and their increase in value is quite high. The export of electronics products in China was 350 million US dollars in 1986, a growth of 52 percent over the previous year; in 1987 it was 500 million dollars, a growth of 42.9 percent over the previous year, but was only 1.25 percent of gross export values for the entire country. The base figure is quite small and belongs to an initial stage. We can refer here to the "four little dragons."

During 1986, electronics products from the "four little dragons" were in proportion to the gross value of exports as follow: 20 percent for South Korea, 40 percent for Singapore, 22 percent for Taiwan Province, and 21.7 percent for Hong Kong. We could presume 20 percent as the proportion of electronics exports within the gross export value by the end of this century, and then the export value for Chinese electronics products would reach 40 billion US dollars by the end of the century, or 28.6 percent of the value of electromechanical product exports. From 1987 until the end of the century, the average annual rate of growth would be 40 percent.

Computer products: although computer products are part of high-technology products, one portion of their components and low-grade products are products that combine labor intensity with technology intensity, and these could be products China can export to generate foreign exchange.

The export of computer products from China is more or less at the same initial stage as were the "four little dragons" in the early 1980's. Although the basic figures are quite low, with correct guidance this can grow quite quickly. Take Taiwan Province as an example. The export value of its computer products was only 5 million US dollars in 1980, in 1982 it grew to 160 million, and in 1987 it was at 3.79 billion dollars. From 1982 through 1987, the average annual rate of growth was 88.3 percent. The export value of South Korean computer products rose from the 199 million US dollars in 1983 to 840 million in 1986, for an annual average rate of growth of 61.6 percent.

In 1987 the export value of Chinese computer products was only 45 million US dollars.

To aid in making estimates, we can presume an average annual rate of growth for the value of Chinese computer product exports to be 50 percent from 1987 through the end of the century. The export value by the end of the century would be 5.9 billion US dollars, or 3 percent of gross export values at that time and 14.7 percent of the export value for electronic products. Taking the total for exports from the "four little dragons," the proportions for those two categories were 3.8 and 21.5 percent, respectively.

It would appear that the objectives of our efforts toward export values for Chinese computer products might be raised. But we must first of all pay careful attention to the current initial stage.

Computer software: software products are both knowledge and technology intensive, and are also labor intensive. The demand for software has grown quickly worldwide, but there are not enough software personnel, so supply cannot meet demand. Because China has abundant manpower resources and we are well known for our intellectual capacities, software exports could be a potential advantage for China. But because national conditions are different among countries, and because languages are different, this can require some time, but practical experience can bring about the maturity of software personnel.

It must be pointed out that the development and export of software products requires that the means by which people leave and enter China must be as convenient as possible. At the present time, the means by which China inspects and approves paperwork are too complex, and this has seriously obstructed the export of software. This will only gradually be resolved as our restructuring intensifies.

The export of software products can now occur only on a small scale. It is estimated that there will be no breakthroughs in the near term. But we must actively bring about the conditions such that we can provide leadership and encouragement, because this could be a springboard to high technology for China's industry.

7. We must set up the correct guiding ideology and formulate industrial policies for the generation of foreign exchange by export.

If we are to select 200 billion US dollars of gross export volume as our objective for the end of this century, that requirement cannot be considered too high. In the beginning few years, growth could be somewhat faster, but if we are to maintain stable growth over a long period, as well as achieve an optimization of export commodity structures and establish a base for future industrial advancement, we must choose a series of effective measures. This is especially true for the export of electronics and computer products, where we lack experience, and where thus it is quite necessary for us to learn from the experience of the "four little dragons" and other developing nations.

Widen prospects for the earning of foreign exchange through exports--attract foreign investment.

Bringing in foreign investment played a determining role in the situation regarding the generation of foreign exchange through exports for the "four little dragons."

In 1985, as far as the output value of computers was concerned, in Taiwan Province, South Korea, and Singapore a great proportion of the foreign investment went into building factories and manufacturing. Those proportions were 48, 56, and 82 percent, respectively.



Before 1983, there nearly was no computer industry in Singapore. But by 1986 their Winchester disk-drive production had reached an output value of 950 million US dollars, and they were making 4 million of them, 45 percent of world production. They are one of the world's three major bases for disk-drive production (the United States, Japan, and Singapore). Nearly every disk-drive manufacturer in the world has a branch factory in Singapore.

There are currently more than 20 foreign firms investing in the integrated circuit (IC) industry in Malaysia. In 1987 exports of ICs reached 1.48 billion US dollars, the third largest exporting nation of ICs in the world. During the last 2 years, income through foreign exchange from export products of the IC industry in Thailand has become second only to that from textiles, and in 1987 annual output volumes reached 650 million pieces, generating foreign exchange in the amount of 558 million US dollars. At present, there are seven IC firms in Thailand, five of which are foreign funded and the other two are jointly funded.

The experiences of these countries and regions have been: to bring in foreign investment, by which they cannot only resolve problems with funding, but bring in manufacturing technology, operations management technology, marketing technology, and market networks as well. This also opens channels for the purchase of raw materials. These things are what China lacks and needs.

We may say quite firmly that bringing in foreign investment is the window of opportunity by which China's computer and IC high-technology industries can generate foreign exchange through exports. This experience can be of value to other industries. too.

We should not proceed solely from technology, but should place primary importance upon the generation of foreign exchange through exports. As far as technology is concerned, we can begin at a lower level and rise to a higher.

IC firms in Thailand and Malaysia work only on the final assembly process and on testing. Although they have only become familiar with rather simple technology, all their products are exported, and each year they receive much foreign exchange in return, and they have trained many technicians, management personnel, and foreign sales personnel.

Exports of computer products from Taiwan Province were still at an initial stage in 1981, and 87 percent were primarily comprised of low-grade products such as computer components and interface boards. By 1982 that had dropped to 60 percent, to 31 percent in 1983, and by 1984 and thereafter that declined and rose according to the demand of the international market. Computers began with the 8-bit microcomputers of 1983, and now, they not only export 32-bit microcomputers, but also have begun exporting mini-computers.



As we develop our computer exports, we, too, can consider beginning from components and low-grade products. In the initial stages, we can concentrate on "opportunistic products," where as long as we have opportunities for export, whatever the level of technology we can arrange for production. After we have accumulated some experience we can then shift to "target products," where we can foster the conditions through which to seek to export products we select. We can gradually rise in the level of technology.

Large economies of scale are not necessarily best.

We have become accustomed to treating scale as an important condition by which to evaluate enterprises, and even joint ventures. This has led people to seek large projects with high investment. This way of thinking must change.

This is especially true for the initial stages of the export of computer products, where because we have insufficient funds and lack experience, we should correctly understand economies of scale. Although considerable funds are necessary for factories assembling computers, they are not capital intensive, and we should begin with these small-to-medium enterprises and should not wait for the state to fund them, thereby losing a good opportunity.

In 1985, there were more than 2,000 factories and businesses in the computer industry in Taiwan Province. They employed 30,000 people, had capital of 200 million U.S. dollars, and were mostly small-to-medium enterprises. Their annual generation of foreign exchange was 1.22 billion U.S. dollars.

In the process of strengthening the generation of foreign exchange through exports, steadily increase the component that is independent and autonomous: the attraction of foreign capital does not mean long-term reliance upon foreign capital.

By comparing benefits, we should look at the self-sufficiency of products--this for the sake of replacing imports and to make technology Chinese.

In the beginning stages of the export of a particular product, either a portion or the entire raw materials will have to be imported, even to the extent of being the "processing of imported materials." This is permissible, even necessary, but this is not a goal to be pursued. When markets abroad have reached a certain scale, we should compare benefits to determine the extent to which the technology should be made Chinese. The goal here is to lower costs, increase profits, and improve competitiveness. After a strong capacity for export has been achieved, in certain circumstances a temporary loss is even permissible in order to get out from under foreign control.

Key components for computer products from South Korea, as for example magnetic heads, stepper motors, and spindle motors, formerly all needed to be imported. In 1986, they formulated their "plan to improve the rate of self manufacture for computer products," which has gradually come to be applied to integrated circuits, large capacity diskette drives, power supplies, multi-layer printed circuit boards, and small motors. Taking microcomputers and printers as

examples, the rate of self production in 1986 was 30 and 35 percent, respectively, and by 1987 both were at 50 percent. It is planned that by 1990 the rate of self production of the majority of computer products will be 90 percent and higher.

In summary, as far as replacing imports is concerned, making the technology Chinese or improving the rate of self production must be based upon a comparison of benefits. The extent of this can only grow with the improvement in capacity for generating foreign exchange from exports. But long term, unconditional reliance on foreign countries is naturally unacceptable, nor should it be advocated.

From OEM products to self-designed products under our own labels.

In the initial stage of product exports, buying and selling in international markets might have to depend upon foreign concerns, and therefore some products will be sold as OEM products. We eventually want to set up our own buying and selling networks abroad and to study development bases so that we might work to develop our own products internationally.

8. We should strengthen overall control and guidance, and guard against making a big effort with no follow-through.

In the import/export trade, the generation of foreign exchange through exports has a primary place in the developmental strategy for our national economy. To a very great degree, it is a determining factor for national industrial policies and the occurrence of industrial structures. Even though we want to be unrestrictive as far as microcomputers are concerned, from an overall perspective we must strengthen control and guidance to avoid making a big effort without following through, and to allow for a healthy development.

The generation of foreign exchange through exports is being considered from the perspective of the entire country. There will be different requirements for different regions, different industries, different enterprises, and at different times. For example:

Enterprises in the interior must contend with domestic markets, and must also take advantage of surpluses and supplement shortages in manpower and materials with the coastal regions, where both regions make trades with one another. Certain products from a minority of large cities and enterprises will enjoy comparative advantages, and they, too, can join the ranks of those generating foreign exchange through exports.

We must continually adjust export commodity structures. We should give a free hand to the export of high-technology products. Primary products, and especially the export of agricultural products and energy should be more tightly controlled, but we should not fail to provide encouragement on a case-by-case basis.

The major portion of the computer industry is in the coastal region, but domestic markets cannot quickly expand in a short period, so we should concentrate on being led by exports. But for some products the domestic markets are quite large, as for example for Chinese character typewriters; or those products are very specialized, as for example with industrial electronic equipment needed for enterprise technological transformation, and in those cases we should thoroughly adopt a policy of replacing imports.

We should formulate preferential policies for export that will allow enterprise exports to be profitable; we should encourage enterprises to take advantage of opportunities, to meet the demands of international markets, and we should not draw up overly detailed rules that we would like to see, which would be done to ensure a balanced growth and would shackle enterprises.

We should make reasonable use of foreign exchange and realize that the generation of foreign exchange through exports is equally important. We should make a distinction between selling abroad and domestic demands. We should be generous in spending foreign exchange as part of selling abroad, but should be stricter about doing so for domestic needs.

9. The key is to hasten and intensify the transformation.

Because China has been an isolated nation for nearly 30 years, we cannot in all aspects meet the demands of our opening to the outside. The greater international scene and the generation of foreign exchange through exports is one component of the opening to the outside, and this has posed a particular and strict demand on the transformation. This involves a great deal of area, including all the aspects of concepts, organizations, procedures by which we do things, basic facilities, and working attitudes, and this includes the enterprises themselves. Looking just at organization and links, areas such as foreign trade organization, the means of project approval, management of foreign exchange, the entry and exit of personnel, the circulation of skilled personnel, the distribution of foreign exchange, investment abroad, and customs management, all need to be wisely dealt with. As far as basic facilities are concerned, what are most pressing are conditions of transportation, communications, and daily living. What is most difficult but easily ignored are changes in concepts and attitudes. Changes in these two areas are most important, and will eventually prove the determining factors.

This is especially true for all aspects of the restructuring that must be both coordinated and synchronized, and even more the restructuring must propose higher and more far reaching demands as the opening up intensifies and broadens.

The demand just described on the restructuring are objective requirements that have a great degree of difficulty. But their progress will determine the success of the economic upswing of our country. This is the primary matter that faces China. In fact, it governs the entire deployment of our restructuring throughout the country.

#### 10. Conclusions.

That the computer industry become part of the greater international scene is a requirement for the growth of our national economy, and it is also a requirement for the growth of the computer industry itself. The place it occupies in China's national economy and within the gross value for exports, while not large in the near term, will gradually catch up with and surpass other industries because it is a rising new high-technology industry that also requires little capital investment, produces results quickly, increases in value, and conserves natural resources. It will also make extraordinary contributions to the national economy and to the generation of foreign exchange through exports. It is different from other capital-intensive heavy industries in that its growth and exports generate foreign exchange, for which reasons it should not be held back, but rather should receive the concern and respect of the state.

The problems encountered in the generation of foreign exchange through exports contain many similarities with other industries, and these can only be progressively resolved through the deepening restructuring.

12586/7310

Policy for Territorial Development, Resource Utilization, Environmental Utilization, Environmental Protection

40081080 Beijing ZHONGGUO HUANJING KEXUE [CHINA ENVIRONMENTAL SCIENCE] in Chinese Vol 8 No 2, Apr 88 pp 47-52

[Article by Tang Yijian [0781 0110 0494] of the Geography Institute, Chinese Academy of Sciences: "A Preliminary Discussion of China's Territorial Development, Resource Utilization, and Environmental Protection Strategies and Countermeasures"]

[Excerpts] Abstract

Starting with the perspective that over-concentration of population and industries, insufficiently rational resource utilization, and poor management are the main causes of environmental pollution and deterioration, this article calls for using target planning and comprehensive control to control and protect the environment. It also considers the strategic principles for environmental protection in China to be: 1) Coordinated unification of economic benefits, social benefits, and environmental benefits; 2) Control principles giving priority to prevention, integration of prevention and control, and comprehensive control; 3) Upholding the systematic ideology of integrating planning, control, and management. This requires the adoption of four countermeasures: 1) Comprehensive planning and rational deployment; 2) Comprehensive utilization to convert harm into good; 3) Waste re-use and biological control; 4) Unified leadership and strengthened management.

## II. Environmental Protection Strategies and Countermeasures in China

### 1. Principles and bases for formulation of environmental strategies in China

The basic goal in developing production and protecting the environment in a socialist nation, whose main goal of struggle is the interests of the people, is to satisfy the people's needs of material life and spiritual life to the greatest possible extent. This is the fundamental principle in territorial development and the formulation of environmental strategies in China. For this reason, we must 1) Achieve coordinated unification of economic benefits, social benefits, and environmental benefits; 2) Implement control principles giving priority to prevention, integration of prevention and control, and comprehensive control; 3) Uphold the systematic ideology of integrating planning, control, and management.

When formulating environmental strategies in China, we propose the adoption of target planning goals and comprehensive control similar to the outline goals implemented in the Soviet Union. Both integrate territorial development, resource utilization, and environmental protection into a single entity. They employ the concepts of economic ecology when formulating national economic development plans and make full use of the newest achievements in science and technology to develop forces of production. They fully rationally utilize natural resources and maintain relative natural ecological equilibrium to attain the goal of expanding production while protecting the environment. Production technology levels in China are still rather low at present, however, and our economic strengths are limited. Moreover, we have a vast territory, complex and variable natural conditions, and substantial regional differences in environmental capacity and environmental load-bearing ability. As a result, China's environmental strategy must fully embody the goals of different regions and different periods, and adopt different comprehensive control methods. To achieve this, we must strengthen research on environmental zoning at different levels and establish environmental planning for all of China on the foundation of solid and realistic feasibility.

## 2. Main countermeasures for achieving environmental protection strategies and goals

We must summarize positive and negative experiences in environmental work in China over the past 10-plus years. On the basis of China's concrete conditions and in consideration of the possibility of future S&T developments, strategic goals for the environment should be formulated simultaneously with the overall goal of becoming relatively well-off by the end of this century. We should strive for fundamental control of the trend toward ecological deterioration and environmental pollution in China and improve environmental quality in key cities and regions. We feel that this environmental goal can be achieved if the measures are appropriate and countermeasures are implemented. To this end, we must adopt the corresponding environmental countermeasures.

### 1) Comprehensive planning, rational deployments

A city or development region is a comprehensive regional entity which closely integrates natural environmental conditions with socioeconomic structures. It is a complex ecological system composed of the three main factors of nature, society, and the economy. The rationality of its structure and regional distribution have major effects on productivity and environmental quality for the region as a whole. For this reason, in regional development, industrial deployment, and urban construction, we must give attention to these principles: 1) The needs of social development; 2) Appropriate natural conditions; 3) What is allowed by environmental capacity; 4) Real economic possibilities. Practice has proven that over-concentration of population and industry is a primary factor in environmental pollution and environmental deterioration. From the perspective of economic benefits, however, relative concentration of various industrial structures to form a complex industrial production chain and urban life services network has definite advantages in making full use of productivity within an industry, improving S&T coordination levels, reducing costs and investments, increasing the value of output,

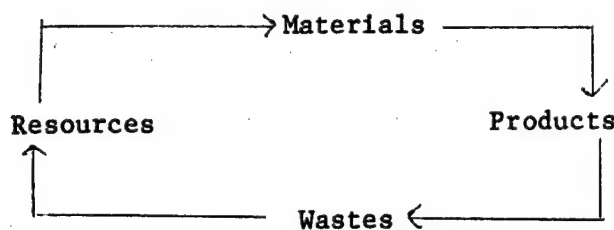
stabilizing standards of living, and other areas. Thus, when making regionaleconomic development plans and deploying forces of production, we should strive to make industrial structures conform to a regional economic optimization process for sustained and effective development of the forces of production with a prerequisite of not damaging the ecological equilibrium and not causing environmental pollution or environmental destruction. This requires guidance on the basis of regional location theory or ecological location theory to carry out rational planning, evaluation, and selection. For example, to reduce pollutant discharge as much as possible, industrial deployment must make increasing the comprehensive resource utilization rate to the greatest possible extent the highest standard for their environmental goals. Thus, besides requiring that large industrial enterprises which consume large amounts of energy and investments (or materials) be near raw material production base areas, the best option would be to form a large integrated industry (or industrial production chain) to permit comprehensive utilization of natural resources and industrial sideline products while simultaneously attaining the goals of reducing pollution and protecting the environment.

Industrial deployments also must consider regional environmental capacities, which vary with changes in environmental standards and regional environmental self-purification capacities. Moreover, differences in biology, climate, and water distribution also cause self-purification and dilution capacities for different pollutants in different types of industries to vary. Similarly, differences in the character of cities and levels of development also will lead to substantial differences in population, industry, and pollutant capacities. For this reason, we should carry out comprehensive planning and deployment of industrial and agricultural production according to environmental conditions in different regions.

## 2) Comprehensive utilization, converting harm to good

The ecological principle that all things on heaven and earth have their place tells us that a complete natural ecological system denies the existence of useless waste materials in the natural world<sup>2</sup>. The so-called three wastes [waste gas, waste water, and industrial residue] we now see exist only because no proper home has been found for them. This is only a type of "wrong place." The reason is that from the perspective of the matter recycling process, the earth's resources, including renewable ones (water, forests, crops, and so on) and non-renewable ones (fossil fuels and metallic ores) can become raw materials (such as lumber, farm and sideline products, petroleum, minerals, and so on) for use by mankind via cutting and extraction, and they can be processed into paper pulp, metals and other materials, after which they can be manufactured into useful commercial finished products. So-called "waste materials" which cannot be fully utilized are released into the atmosphere, water, or land during processing and manufacturing to form the "three wastes" which pollute the environment. Actually, many of these "wastes" can be re-used as raw materials for other products via comprehensive utilization, closed cycles, and other patterns. Others can be returned to the earth through natural purification, land treatment, and other means to become renewable resources.





During this cycling process, the degree of utilization of these "wastes" is determined by technical levels and economic strengths. The relationship can be expressed in a simple formula:

$$\text{Wastes} + \text{technology} = \text{Potential sources}$$

It is apparent that there is no insurmountable chasm between wastes and resources. As social demand increases, existing natural resources may be noticeably inadequate and the inability of supply to meet demand may substantially raise prices, just as Marx said in "Das Kapital": "A situation of increasing expensive raw materials naturally creates a stimulus for the utilization of wastes" which in turn promotes the development of materials science and technology to increase the capacity for resource utilization. This involves "converting materials formerly unusable under original patterns into other forms which can be used in new production."<sup>4</sup> Now, many low-grade ores which were considered wastes in the pasts are being converted from "low-grade" into "high-grade" ones because of advances in smelting technologies. Today, coal is no longer just a fuel but instead is a raw material used to produce many dyes, medicines, clothes, and foods. Thus, utilization of resources and their social value will have different meanings at different stages of social development, and resources now are a function of science and technology.

Analysis of the development of human society and the extent of its effects on the environment shows that deterioration of the natural environment and environmental pollution are produced mainly during resource exploitation and utilization. Thus, we must begin with environmental protection as well as with resource exploitation and utilization. An example is reforms in production technologies and integrated design to convert residual wastes from one plant into raw materials used for production in another plant by forming an integrated industry (industrial production chain) which has no or fewer wastes and no or less pollution. Moreover, we can change the structure of raw materials (and fuels), improve the thermal efficiency of fuels, recycle more water, and so on to reduce discharges of waste gas, waste water, and industrial residues in cities and in industrial and mining enterprises. Based on the current situation in territorial planning of industrial deployments and arrangements in the Seventh 5-Year Plan, China still must reinforce construction along its eastern coast as well as in northeast and north China and other old industrial regions before the year 2000. However, these regions already have a serious pollution load, and they are experiencing water shortages which have become the main factor restricting development of the national economy. Most of these areas now have a water re-utilization rate



of only about 40 percent, much less than advanced international levels. Thus, reducing water consumption coefficients and increasing water re-utilization rates obviously is of particular importance.

### 3) Re-use of pollutants, biological control

Zero discharge is not possible given existing production technology levels, so a certain amount of pollutants will always be discharged into the environment. China's limited economic capacity at present would be hard pressed to provide substantial funds to control environmental pollution before 2000, so again we must exchange the smallest possible environmental costs for maximum possible economic benefits. We must pursue many routes to deal with environmental pollution. One important route is to turn waste water into a resource by using it for irrigating farmland and breeding. The theoretical foundation for this is selective absorption by organisms, biological deterioration, soil adsorption, and soil retention. This attains the goal of pollutant purification and is called a land treatment system. By placing these pollutants on farmland and grassland, a complete matter cycling system made up of producers (crops or grasses)--consumers (earthworms and other animals)--decomposers (soil microbes) can be formed. This is an emerging process which uses pollutants to breed new life. Practice has shown that the land treatment system is extremely effective in eliminating biologically decomposable organic matter, suspended solid matter in urban waste water and industrial waste water<sup>5</sup>.

Similar ecological principles can be used to separate urban solid wastes. Besides re-using various metals and other recoverable materials, some industrial inorganic solid wastes can be used as building materials and filler for payment. Household garbage and organic crop residues can be undergo oxidation, fermentation, and other processes for utilization as organic resources.

Afforestation and the establishment of ecological functional buffer zones can beautify the environment and reinforce the vitality of ecological functions, and it can improve the living environment because most trees and grasses have many advantages by playing a role in absorbing dust, decomposing toxins, sound barriers, and sterilization.

### 4) Unify leadership, strengthen management

Resource utilization, economic development, and environmental protection are the fundamental criteria in our work. However, our ability to deal properly with the restrictive relationships among them still is determined to a great extent by leadership techniques and management levels.

Our current environmental problems involve many complex problems in territorial development, resource utilization, and other areas which appeared throughout China during the development of social production. Thus, they require unified leadership and policymaking structures to deal with the many planning, coordination, control, and management issues. Moreover, China's

current territorial planning and environmental planning are under the jurisdiction of two parallel structures and the work is hard to unify, which has made controlling environmental pollution and improving the ecological environment very hard to implement.

So-called unified leadership and strengthened management refer to the real need for unity in ideology, principles, and policies to deal with the contradiction between territorial development and environmental protection. Afterwards, management by categories and by levels can be implemented according to the specific system and level. Thus, we should apply the concepts of economic ecology and carry out national and regional ecological environmental zoning, categorize and evaluated several major development and construction projects, formulate policy provisions which conform to scientific principles, and employ legal procedures to adopt effective administrative measures and implement effective supervision and management. At present, it is particularly important that we be concerned with coordination and management of territorial development with ecological equilibrium, and between urban and rural construction and environmental protection.

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12539/12232

## Status of Titanium Mining in China Reviewed

40080148 Beijing ZHONGGUO DIZHI [CHINA GEOLOGY] in Chinese No 4, 13 Apr 88  
pp 22-24

[Article by Yang Shunshu [2799 7311 2873] of the Panxi Geological Brigade, Sichuan Bureau of Geology and Mineral Resources: "Exploitation and Development of Titanium Ore Resources in China"]

[Text] Ninety percent of titanium ore resources are used in the titanium white pigment industry and it is an important raw material in the production of paint and ink, paper and plastics. Titanium metal and titanium alloys are used in the aviation and aerospace industries, seawater desalination, power generation equipment cooling systems, and other areas. It is an excellent metallic structural material and holds the status of a strategic metal.

## I. An Evaluation of China's Titanium Ore Resources

## 1. Numerical advantages

There are 23 foreign countries or regions which have economically proven reserves (calculated on the basis of titanium dioxide) of 400 to 450 million tons. In China, two-thirds of our provinces, municipalities, and autonomous regions have proven reserves. Their buried reserves comparable to the economically proven reserves in foreign countries amount to several 100 million tons, more than the total industrial reserves of the world's seven countries with the largest resources, Canada, Norway, India, the Soviet Union, Australia, South Africa, and the United States, and almost as much as the economically proven reserves of the 23 foreign nations and regions. However, China's sand deposit resources, particularly our rutile sand resources, are much smaller.

Chinese and foreign ore categories and their proportion of reserves are shown in the following table:

Area	Ilmenite rock resources (percent)	Ilmenite sand resources (percent)	Rutile rock resources (percent)	Rutile sand resources (percent)
Foreign countries	72	21	--	7
China	93	4.9	1.9	0.2

## 2. Slightly low grade of raw ore

Five mines in four foreign countries extract and dress endogenous ore deposits. The grade of the raw ore (titanium dioxide, same below) in these mines is 13 to 19 percent. At Finland's (Aodanmeiji) pit extraction mine, iron, vanadium, and titanium are recovered in a comprehensive fashion, and the raw ore grade is 13 percent. The grade is 19 percent at the (Sangfude) mountain open cut mine in the United States. The grade is 18 percent at Norway's (Te'ernisi) open cut mine. Canada's (Alaide) Lake open cut mine extracts hematitic ilmenite and the grade of the coarsely refined ore is as high as 34.3 percent. The grade at China's Panzhihua Mine in Sichuan is about 10 percent.

Eight foreign countries are the primary extractors and dressers of exogenous deposits: the east and west coasts of Australia, Richards Bay in South Africa, New Jersey and Florida in the United States, (Alalabang) in India, the southeast coast of Sri Lanka, (Wukelan) in the Soviet Union, the southwest coast of Sierra Leone, and the southeast coast of Brazil. The sand deposits in these nations are rich in both ilmenite and rutile. In India, for example, they contain 80 percent heavy sand, more than one-half of it ilmenite. They contain 10 to 25 percent rutile in Australia and Sri Lanka. China's sand deposits generally contain only a few percent ilmenite, with a few containing over 10 percent.

## 3. Reserves are concentrated mainly in Sichuan

The titanium resources (endogenous rock ore) at Panzhihua account for 92.7 percent of China's listed reserves and for 96 percent of listed reserves in the same category.

## II. The Current Situation in Resource Utilization and Extent of Resource Guarantees

China held eighth place worldwide in 1985 in refined titanium ore production (calculated on the basis of titanium dioxide, same below), after Australia, South Africa, the United States, Canada, Norway, the Soviet Union, and India. Our resource utilization rate was only 0.03 percent.

In foreign countries (1980), 39 percent of their refined titanium ore output came from rock ore resources and 61 percent from sand deposit resources, a 2:3 ratio, with 85 percent coming from ilmenite resources and 15 percent from rutile resources. For ilmenite output, 42 percent came from rock ore resources and 58 percent from sand deposit resources. All of their refined rutile ore came from sand deposit resources. In China's refined titanium ore production, 95 percent came from extraction and dressing of sand deposit resources from the sand deposits of Guangdong and Guangxi. China still does not have a mine for rutile production on any significant scale and no definite production capacity

has taken shape. The ratio between refined ilmenite and refined rutile ore output in China was 30:1 in 1983 and 27:1 in 1985, which is significantly different from foreign countries.

The gratifying aspect is that there has been substantial growth in refined ore output from ilmenite in China in the past few years, with output in 1986 three times that in 1985. We also sold several 1,000 tons on foreign markets in early 1987.

According to data from the Bureau of Earth Sciences and Raw Materials in the Federal Republic of Germany and the "Mining Journal" in the United States, the average rate of growth in refined titanium ore output in foreign countries during the 1970's was 2.4 percent and fluctuated within the range 2 to 4 percent. Calculated on this basis, foreign countries may produce 3.6 to 4.37 million tons of refined titanium ore in 1990 and 4.4 to 6.48 millions tons by the end of this century. Total output for the period 1981 to 1990 may reach 33 to 36.9 million tons, equal to 8 to 10 percent of foreign economically proven reserves. Total output for the period 1981 to 2000 may reach 73 to 92 million tons, equal to 18 to 22 percent of foreign economically proven reserves.

Refined titanium ore output in China generally has grown by 80 to 100 percent over a 10-year period and by 25 to 50 percent over a 5-year period. Projected on this basis and using output in 1985 as the foundation, output by the end of this century may be 1.5 to 2 times output during the 1980's.

It will not be possible to achieve any substantial increase in titanium ore resource reserve in China or foreign countries during this century.

With growing output and relative stability of reserves, we can predict the expected lifespan of titanium ore resources. Foreign countries can extract in a static manner for 139 years, with 151 years for ilmenite and 66 years for rutile. Seven nations, Sierra Leone, India, the Soviet Union, Norway, Canada, the United States, and Brazil, can extract for more than 100 years. Two nations, Finland and South Africa, can extract for 50 years or more. Three nations, Sri Lanka, Australia, and Malaysia, can extract for less than 50 years. Foreign countries can extract for 66 to 47 years in a semi-dynamic fashion (at a 2 to 4 percent annual growth rate), with 69 to 48 years for ilmenite resources and 41 to 32 years for rutile resources. At a yearly growth rate of 6 percent, they can extract for 37 years (38 years for ilmenite resources and 26 years for rutile resources). Five nations, Sierra Leone, India, the Soviet Union, Norway, and Canada, can extract for 50 years or more. Four nations, South Africa, the United States, Sri Lanka, and Finland, can extract for 30 years or more. Three nations, Australia, Malaysia, and Brazil, can extract for fewer than 30 years.

In the recovery of titanium resources from coulsonitic titanomagnetite in China, the number of years in which extraction is possible must be calculated differently because of different resource categories. Only a rough estimate

can be made of the number of years during which extraction is possible in China's main refined titanium ore producers, Guangxi, Guangdong, and Sichuan. The results of the calculations are that, using refined ore output in 1985 and a yearly growth rate of 10 to 12 percent, China can extract for 42 to 49 years in a semi-dynamic fashion. Guangdong and Guangxi can extract for 30 years or more and Sichuan can extract for 53 to 62 years. It is apparent that titanium raw materials in China and in foreign countries are a "long-line mineral" with reserve strength.

### III. Competitiveness of Refined Ilmenite Ore From Panzhihua

The grade and transportation conditions at Panzhihua are not as good as those of the sand deposits in Guangdong and Guangxi, but because its current price is about half that of ore from Guangdong and Guangxi, it still has market prospects. The refined titanium ore from Panzhihua is in no way inferior to similar refined titanium ore in Norway, Canada, or other countries, and the grade of its titanium dioxide is even higher. Although it has a slightly higher calcium and magnesium content, acidolysis, purification, hydrolysis, water dressing, and other processes can be used in the sulfuric acid method of producing titanium white to separate them from the titanium dioxide, making it unlikely that they will get into the product. Moreover, China uses electrically-heated ovens and sieveless ovens which have already successfully dealt with chlorinated extraction of titanium tetroxide, indicating that Panzhihua has the potential to compete with similar categories of refined ore from Norway, Canada, and other nations.

Panzhihua's titanium resources exist in the form of associated components of iron ore. As the iron and steel industry develops, the extraction of raw iron ore at Panzhihua also can provide the incidental benefit of extracting rich titanium resources, about half of which can be made available for recovery. Research on the utilization of Panzhihua's titanium resources and the conversion of achievements in attacks on key scientific research topics are a basic developmental strategy for titanium in China.

### IV. Titanium Ore Geological Work and the Direction of Titanium Resource Exploitation and Development

Fostering China's titanium resource advantages requires us to start with real conditions in China.

The overall strategy should be: full utilization of the abundant titanium ore resources in the Panxi region of Sichuan, additional research and improvements in ore dressing technologies, higher refined ore quality, expanded ore dressing capacity and production scale, reduced costs to meet the goal of breakthroughs based on the characteristics of Panzhihua's raw materials, and relying on southwest China's rich hydropower conditions to develop the production of titanium-rich materials and provide sufficient raw materials for China's titanium white and sponge titanium industries.

The first step, a short-term campaign for this century is: deploy rutile ore prospecting work, select sites for evaluation, develop rutile ore production base areas with good technologies and economic feasibility, and strive to attain product self-sufficiency; make additional plans to develop ilmenite sand deposit resources along China's southeast coast, and reinforce leadership over civilian extraction and rational utilization of the scattered high-quality ilmenite resources along the coasts of Guangdong and Guangxi and in the river basins of southeast Guangxi; begin by converting achievements made in attacks on key scientific research topics for Panzhihua's titanium resources into forces of production, make suitable deployments for the industrial production of titanium-rich materials in southwest and northwest China, particularly by establishing a titanium dregs plant for local extraction in Sichuan, and lay a good foundation for comprehensive utilization.

The second step, a long-term campaign for the end of this century and the beginning of the next, is: focus on utilization of Panzhihua's titanium resources, with a secondary emphasis on the titanium resources of Guangdong, Guangxi, and other regions, and make comprehensive arrangements for deployment of the titanium white and sponge titanium industries in China. Ensure that the grades of titanium white, quantitative self-sufficiency, and sponge titanium are based on civilian uses in China.

I predict that within about 30 years, China's titanium resource advantages can be converted in industrial advantages.

Proposals concerning geological work based on the above outline are:

First, we can slow the pace of prospecting work for coulsonitic titanomagnetite.

Second, deal with the current situation of inadequate supplies of rutile raw materials and re-evaluate existing rutile deposits. Expand research on rutile mineralization theory and on the geological conditions of mineralization, summarize the laws of mineralization of China's rutile (especially metamorphic deposits), strengthen mineralization forecasts, and deploy rutile survey exploration projects. Analyze the prospects for rutile ore resources in China and formulate policies for the development and utilization of titanium resources. Examples include debating China's lack of rutile resources and clarifying import principles. At the same time, the development of artificial rutile production will become a focus of China's titanium industry.

Third, many achievements have been made in experiments on industrial utilization of Panzhihua's titanium resources. Work in this area should continue and we should strive to open new realms of research.

12539/08309



# Generation of Tunable UV Laser With Doubled-Frequency Dye Laser

40080156 Chengdu SICHUAN DAXUE XUEBAO [JOURNAL OF SICHUAN UNIVERSITY] in Chinese  
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[Article by Yan Qi [7051 3825]: "Tunable UV Laser Generated by Frequency Doubled Dye Laser," manuscript received 5 Jan 87]

## [Text] Abstract

This paper reports the experimental setup and results of a tunable UV laser. A continuously tunable UV laser from 287.5 to 292.5 nm was obtained by doubling the frequency of a N<sub>2</sub> laser pumped dye laser with KDP crystal. Issues such as higher energy output and better stability are discussed.

Key Words: dye laser, tunable laser, frequency-doubled laser, experimental device.

## Introduction

One way to generate a tunable UV laser is to use a short wavelength laser to pump a tunable dye laser. For example, the dye 2,5-bis(4-biphenyl)bis-diazole (BBD) can output a tunable laser at 370 to 398 nm. In some cases, it is obtained by frequency summing or frequency doubling method. This paper describes a tunable dye laser with two stage amplification which is pumped by a N<sub>2</sub> laser. Its frequency is doubled by passing through a KDP (potassium dihydrogen phosphate) crystal to generate a tunable UV dye laser. The special features of this device include simple structure, ease of operation and low cost. It may be used as a fluorescence spectral source to study the physico-chemical properties of matters in excited states.

## Experimental Device

As shown in Figure 1, it is a tunable laser with a two stage amplifier. The frequency of the laser light is doubled by the KDP crystal to result in a tunable UV laser. The dye laser oscillator and the two amplifiers are pumped by a homemade four channel N<sub>2</sub> laser which is controlled by the same spark gap (only three channels were used in this experiment). The wavelength output is at 337.1 nm. The energy of the pulse is 3.4 mJ in the first channel, 4.1 mJ in the second channel and 3.8 mJ in the third channel. The pulse width is 8 ns.



Because of the high power and narrow width of the  $N_2$  laser, it is distinctively advantageous to use it to pump a dye laser. The dye is a Rhodamine 6G ethanol solution ( $1.2 \times 10^{-2}$  M). The wavelength is 560 to 600 nm and the center wavelength is 581 nm. The length of the dye excited is 16 mm in the oscillator and 20 mm in either amplifier.  $L_1$ ,  $L_2$  and  $L_3$  are quartz cylindrical lenses with a focal length of 100 mm. The tuning element of the oscillator is a 1200 lines/mm grating. The resonance cavity is formed by the first order diffraction and the output lens  $M_0$  which has a partially reflective coating on it. The length of the cavity is 260 mm.  $C_1$ ,  $C_2$  and  $C_3$  are dye containers with quartz windows.  $T$  is a beam diffusing lens.  $A_1$  and  $A_2$  are small aperture optical diaphragms.  $L_0$  is a lens which converts the laser output from the oscillator to near plane wave before sending it into the amplifier.  $M_1$ ,  $M_2$ ,  $M_3$  and  $M_4$  are aluminum coated total reflective mirrors used to adjust the time delay. KDP is the frequency doubling crystal which has a relatively high non-linear coefficient ( $\sim 1.2 \times 10^{-9}$  esu). The phase matching angle with respect to the central wavelength is calculated to be  $\theta_m = 65^\circ$ . The crystal length is  $l = 3$  mm and its cross-section is  $2.5 \times 2.5$  cm<sup>2</sup>[1]

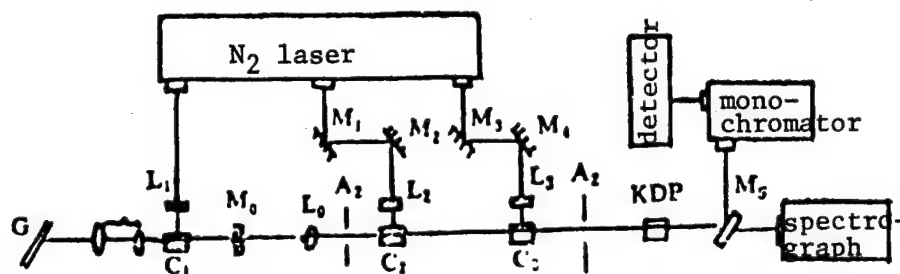


Figure 1. The Tunable UV Laser

In the experiment, the instruments used include a Model NJ-J1 laser energy gauge, a Model WDG 30 monochromator a Zeiss spectrograph and a detector.

#### Experimental Results

The frequency of the dye laser was doubled by the KDP crystal after it went through the two-stage amplifier. It was then measured with a monochromator that it was continuously tunable in the UV from 287.5 to 292.5 nm. The spectrum is shown in Figure 2 (omitted).

In the frequency doubling process, the frequency tuning range of the dye laser is 575 to 585 nm (the dye laser output at both ends of the tunable range was weak, therefore, only the spectrum of this band was taken). The basic spectral output of the dye laser as measured by the monochromator is shown in Figure 3. The frequency-doubled narrow UV laser spectrum is shown in Figure 4.

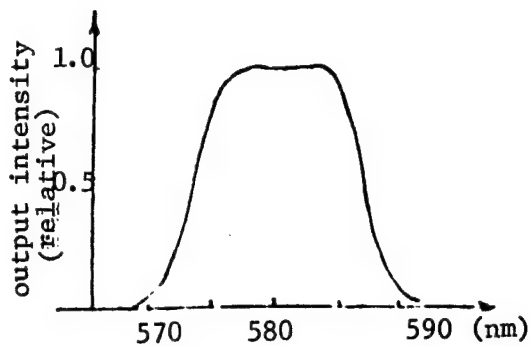


Figure 3. Dye Laser Spectrum

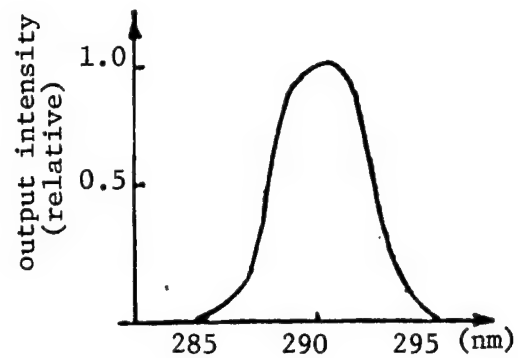


Figure 4. UV Laser Spectrum

#### Discussion

To make this device practical, we should improve its output stability, and enhance the power density of the dye laser and the frequency doubling efficiency. To this end, the  $N_2$  laser circuit should be improved to compress the pulse width and to increase the energy output and stability of the pumping light. Thus, the power density and stability of the dye laser can also be improved. In addition, the synchronous circuit in the channels of the  $N_2$  laser should be changed to a sequential circuit to match the discharge timing requirements between the oscillator and the amplifier. By doing so, the mirror delay mechanism can be eliminated to simplify the device.

In order to gain a higher frequency-doubling efficiency, besides high power density and small divergence angle, the dye laser must have a narrow spectral width. To this end, we can use a Type II matching mode frequency doubling crystal which has a higher efficiency than Type I with narrow spectral width.<sup>[2]</sup>

#### References

- [1] E.T. Arecchi and E.O. Schulz-Dubois, Laser Handbook, North-Holland, 1972.
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12553/08309

Changchun Develops Advanced Laser

40080173c Beijing RENMIN RIBAO (Overseas Edition) in Chinese 12 Jul 88 p 4

[Article by Wang Wenlian [3769 2429 8834]: "Changchun Develops High-Power Advanced Laser for Military Communications and Clinical Use"]

[Text] The semiconductor array large cavity laser developed by the Changchun Institute of Optics and Fine Mechanics recently passed ministry-level certification. This compact laser can deliver hundreds of Watts of power. It is a new development for China and is at the advanced international standard.

Hundred-Watt semiconductor lasers are produced today only by a few countries, including the United States and France. China in the past could only produce low-power lasers. In order to achieve high power, researchers at the Changchun Institute arranged a number of single lasers into a geometric array and, as a whole, the total output power is approximately equal to the sum of the power of the individual lasers. By doing so, they achieved 100-Watt output. Tests of the prototype showed that the laser is stable and reliable, can be assembled readily, and costs much less than foreign models.

This laser can be used for missile guidance, ranging, simulation firing, laser communication, printing and clinical instrumentation development. This research achievement will promote the development of both the defense industry and clinical applications. Today, plants under the Institute are mass-producing the laser.

9698/08309

Developmental Direction of China's Long-Distance Telecommunications Transmission

40080114 Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese  
No 2, Feb 88, No 3, Mar 88

[Article by Xu Naiying [1776 0035 5391] of the First Research Institute,  
Ministry of Posts and Telecommunications: "A Discussion of Developmental  
Directions of Long-Distance Telecommunications Transmission in China"]

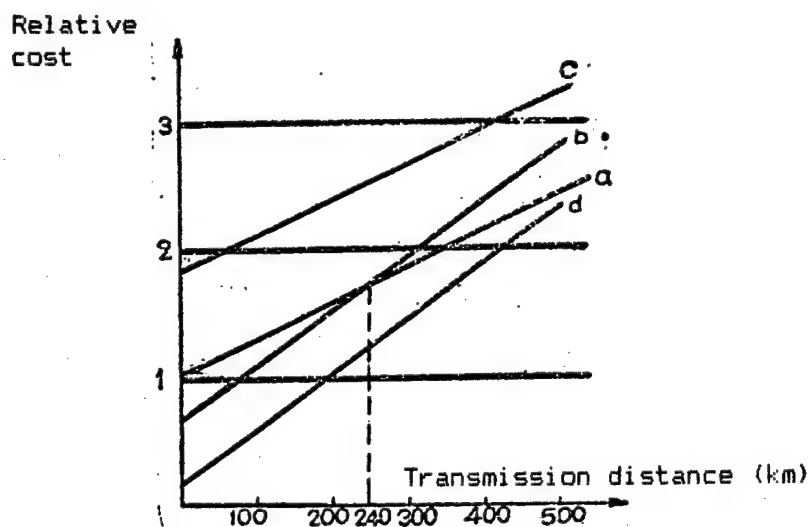
[No 2, Feb 88 pp 2-4]

[Excerpt] Developmental Directions of Long-Distance Telecommunications  
Transmission in China

China is a developing nation with a large population, poor foundation, and vast territory. There are major regional imbalances in economic development and varying geographic conditions. Moreover, state financial resources are limited and it is quite difficult at present to make large investments in posts and telecommunications. Thus, the developmental direction of long-distance telecommunications transmission cannot follow old ways, nor can it fail to integrate with real needs and possibilities in China. We should look toward the developed nations, adopt various transmission means according to local conditions, and use fewer investments at a faster pace to meet short-term communications needs and create excellent conditions for long-term communications development. For this purpose, we should make full use of existing analog networks and carry out the required matching and perfection as well as a small amount of expansion. Work in this area should give appropriate consideration to future digitization. At the same time, certain developed regions, coastal open cities, and regions with more rapid digitization of long-distance switching should adopt digital transmission. We should make full use of wireless transmission means. Satellites should be used not only for international communications and communications with frontier regions within China but also for other suitable situations in China. In the near term, we should work first to meet demand for telephone communications and give appropriate consideration to other non-voice services. Premature calls for construction of long-distance fiber-optic trunk lines or large-scale implementation of ISDN's (integrated services digital networks) are unrealistic.

Based on the above principles, the author feels that the development of long-distance telecommunications transmission in China should involve the following:

1. Make full use of existing analog transmission circuits, strive to meet short-term demand by expanding capacity and exploiting potential. Every other country in the world has tried to make full use of existing analog transmission circuits while digitizing long-distance communications networks. China's analog communications network is not quite perfect, but it does have a substantial scale and there would be economic benefits from fuller use of this network. This is particularly true since space division is employed in most of our long-distance switching, which makes analog transmission circuits more economical than digital transmission over greater distances. Figure 1 shows the curve of the relationship between relative cost and transmission distance for France's long-distance network. The illustration shows that analog transmission is even more economical than digital transmission between space-division switchboards at distances over 240 km.



- a. Analog transmission between space division switchboards
- b. Digital transmission between space division switchboards
- c. Analog transmission between time division switchboards
- d. Digital transmission between time division switchboards

Figure 1

The degree of multiplexing in China's existing analog transmission circuits has not attained advanced international levels and there is considerable potential which can be exploited. Table 1 lists some examples of possible expansions in capacity. The table shows that by expanding capacity, if we assume a 10 percent annual growth rate (equivalent to 20 years multiplied by 6.73, or slightly less than six times) in service volume, the expansion of capacity could meet most demand for 10 years. If the annual growth rate is increased to 15 percent, it still could satisfy demand for about 7 years.

This would delay large investments and reduce pressures on state financial resources, and it would give China time to perfect digital transmission technologies.

Table 1

Type of circuit	Original carrier wave system		Carrier wave system after expansion		Capacity expansion factor	Extension of utilization time after expansion (Note 1)
	No. of voice circuits	Station distance (km)	No. of voice circuits	Station distance (km)		
Intermediate coaxial cable	1,800	6	4,380	3	2.43	9.33
Small coaxial cable	300	8	960	4	3.20	12.20
Small coaxial cable	960	4	3,600	2	3.75	13.87
Four-group paper insulated high frequency symmetrical cable (dual cable) (Note 2)	60	13	900	1.85	2.63	10.13
Single group polystyrene insulated high frequency symmetrical cable (dual cable) (Note 3)	132	12	900	4	3.41	12.87
Symmetrical cable pairs within intermediate coaxial cable (Note 4)	12	12	60	6	5	16.89

- Notes:
1. Assuming a 10 percent yearly growth rate
  2. One group stop/start 60 lines, selecting one pair of circuits to open 90 lines
  3. Both pairs of circuits can carry 900 lines, each serving as a reserve, with only one set open at the same time
  4. The original frequency-division-band 12 lines are changed to frequency-division-band 60 lines, which requires crosstalk balancing

In the area of radio communications, the microwave trunk lines running from Beijing to most provinces, municipalities, and autonomous regions are an enormous potential force. Microwaves are widely used in all advanced countries and more than half the circuits in some nations are carried by microwave. China should work quickly to study terminal encryption equipment, make full use of existing microwave circuits, and overcome the shortage of wired long-distance circuits and large numbers of idle microwave circuits.

In the area of international communications, besides continuing to develop satellite communications and actively studying ways to increase frequency band utilization rates, we should strive to use the Sino-Japanese submarine cable to facilitate communications with all nations of the world via the Pacific and Indian Ocean cables and supplement inadequate satellite communications.

As for open lines which currently predominate in China, they still should play their role fully, especially intra-provincial circuits, and we should open new high-12-line circuits or super-12-line circuits.

2. Transmitting digital signals in long-distance analog communications networks. All low-speed data communications in China at present are transmitted via modems on voice channels. As our economy grows, there may be a need for high- and intermediate-speed data transmission between Beijing and provincial capitals and certain economically developed regions. How can this information be transmitted in existing analog long-distance networks? One method is to use frequency division transmission carriers to provide digital circuit systems, i.e., data in voice (DIV) or data over voice (DOV). The International Consultative Commission on Telephone and Telegraph (CCITT) has made corresponding proposals in Red Book G941 concerning the transmission of a 2,048-kb/s digital system in or above the frequency band of an analog carrier wave system. The actual method used for DIV varies from country to country. France, for example, transmits at a 702-kb/s PCM subrate on a frequency division superrate, while Holland transmits 2,048-kb/s (DS1) PCM on two superrates. For DOV systems, the CCITT proposals are suitable for small coaxial cable 6-MHz (1,260 circuits), 12-MHz (2,700 circuits), and 18-MHz (3,600 circuits) systems, with 2,048-kb/s (DS1) PCM added above the frequency band of these systems. China's intermediate coaxial 1,800-circuit and 4,380-circuit, small coaxial 960-circuit, and other systems also can consider this proposal, and similarly, DIV and DOV systems can be used in analog microwave systems. Moreover, one circuit in the four-circuit audio of an 1,800-circuit color-television microwave communications system also can be used to transmit 2,048-kb/s (DS1) PCM. This is called data over video. A better program is to use an 8,590-kHz audio subcarrier to transmit digital signals.

Table 2 compares the capacity of data transmission of two superrates with one 2,048-kb/s (DS1) PCM when using voice circuits.

Table 2

Capacity Channel category	64 kb/s digital channels	2,048 kb/s digital channels	Two FDM superrates	Capacity ratio
1,200 kg/s data	20	600	120	5
2,400 kb/s data	10	300	120	2.5
300-3400 Hz voice circuits	1	30	120	0.25
Teleconferencing	--	1	5 superrates on one circuit	2.5

It is apparent from Table 2 that DIV and DOV system transmission of voice circuits is uneconomical, while data transmission is much more economical. To achieve better frequency band utilization, the CCITT has recommended multiplex switching equipment, and it has prepared the corresponding proposals (Red Books G791, G792, G793, and G794). The CCITT has defined multiplex switching equipment as equipment which converts frequency division multiplexed signals (such as primary rate or superrate) into corresponding time division multiplexed signals, with the latter having a corresponding structure which derives multiplexed signals from PCM multiplexing equipment. Some people also have inappropriately referred to back-on-back linked FDM and PCM primary rate multiplexers as multiplex switching equipment. Actually, because this type of equipment is connected via audio frequencies, it requires large amounts of primary rate multiplexing equipment, which is the opposite of true multiplex switching equipment, so it is uneconomical. The CCITT has already recommended two types of actual multiplex switching equipment. One type is 60-circuit multiplex switching equipment and the other type is 24-circuit multiplex switching equipment (see Red Books G793 and G794). The former permits interconnection between one superrate and two 2,048-kb/s digital signals, and the latter permits interconnection between two analog primary rates and one 1,544-kb/s digital signal.

Analog and digital systems have coexisted in China for quite some time, so with the exception of DIV and DOV transmission of data information, research should be speeded up on multiplex switching equipment which does not sacrifice voice-circuit capacity.

[No 3, Mar 88 pp 2-4]

[Text] 3. Digitization of analog communications networks. With the coming of the digital era, all nations of the world now are digitizing their communications networks. China's long-distance switching also will undergo a gradual transition to program-controlled digital switching, and the situation shown in Figure 2 will appear. Some developed nations already have completed rather perfect analog networks, so they have compared using their



existing analog circuits with transforming them into digital circuits during the digitization process. Figure 1 shows the results of comparisons made in France.

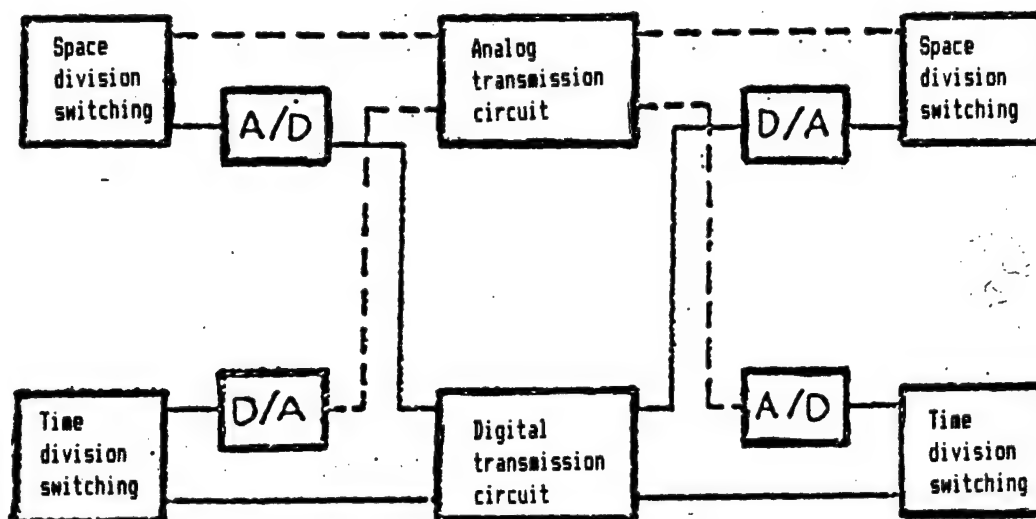


Figure 2

Figure 1 shows that when time division is used in switchboards at both ends, digital transmission circuits must be adopted if they are to be economical. Digital transmission circuits also are economical when switchboards at both ends use space division and when the distance is not too great. Although the price of Chinese-made digital equipment is several times higher than in foreign countries, the trend will be the same in China as time passes. Thus, we must do research in this area as soon as possible. There are two routes to network digitization. One is to transform original transmission media. The other is to build new digital transmission media. Foreign countries also have studied this area. Figure 3 compares the costs of building new fiber optics with digitizing existing coaxial cables. It is apparent from Figure 3 that digitizing old coaxial cables is more economical when there are four systems or less. The traffic in China still is small, and more than four systems would be premature. Thus, we should actively undertake research on converting existing coaxial cables into digital cables. Table 3 shows the refitting situation in foreign countries.

When coaxial cables are opened to digital systems, echo wave attenuation in irregular coaxial tubes must meet certain requirements. CCITT Red Books G623 and G622 recommend the values listed in Table 4.

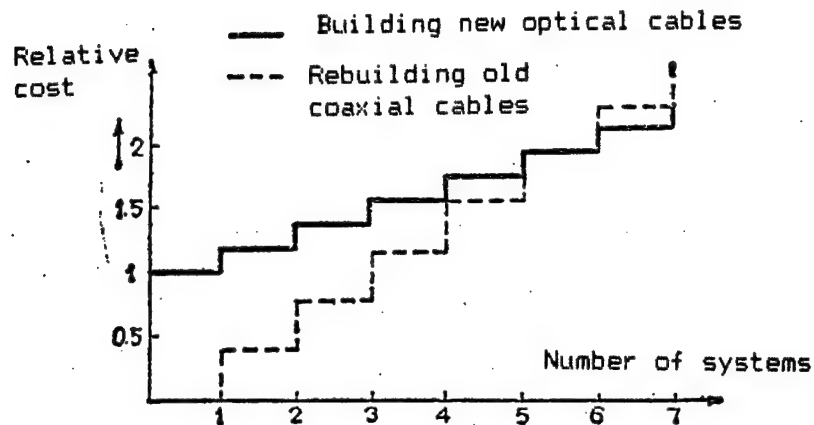


Figure 3

Table 3

Type of cable	Repeater distance (km)	Analog system		Digital system	
		No. of voice circuits	Maximum transmission frequency (MHz)	No. of voice circuits	Transmission rate (Mb/s)
Small coaxial cable	4	960	4	480	34
Small coaxial cable	2	2,700/3,600	12/18	1,920	140
Intermediate coaxial cable	4.5	2,700/3,600	12/18	1,920	140
Intermediate coaxial cable	1.5	10,800/13,200	60/70	7,680	565

Table 4

Type of cable	140 Mb/s digital system			565 Mb/s digital system		
	Frequency band (MHz)	Echo wave attenuation (dB)		Frequency band (MHz)	Echo wave attenuation (dB)	
Intermediate coaxial cable	20-100	100 percent	30	62-500	100 percent	20
Small coaxial cable	20-100	100 percent	20	--	--	
		95 percent	23	--	--	

The author has tested China's medium and small coaxial cables. Our small coaxial cables can meet the echo wave attenuation values shown in Table 4 but medium-sized coaxial cables cannot. Although studies were made as early as 1977 on periodic thickness variations in the outer conductor steel bands of coaxial tubes caused by low echo wave attenuation factors, it was restricted by the quality level of Chinese-made copper bands. Improvements were not possible for a long period and it was not until 1983 that improvements were made by the Shanghai Cable Plant with assistance from a certain copper belt plant in Shanghai, but production of most of the cable was completed by this time. As a result, coaxial cable trunk lines built in China cannot be like the 140-Mb/s digital systems with 4.5-km spacings in foreign countries. Moreover, the repeater stages of China's medium coaxial cable are 6 km and 3 km. More research is needed on ways to make the change. It is possible to open up 2 x 34-Mb/s digital systems at a 6-km spacing and 140-Mb/s digital systems at a 3-km spacing. As for 565-Mb/s systems, there is rather severe structural non-uniformity due to the cable-link distance in China's medium coaxial cables. All the echo wave dissipation peaks due to this type of structural non-uniformity fall within the 130- to 230-MHz frequency band, so it is expected that it will be hard to open up 565-Mb/s systems.

The obvious disadvantage to replacing 12-, 18-, or 24-MHz automated carrier wave systems with 140-Mb/s digital systems is reduced voice-circuit capacity from 2,700, 3,600, or even 4,380 voice circuits to 1,920 circuits. The solution is to use an ADPCM (adaptive differential pulse code modulation) 32-kb/s system. The CCITT recently decided that the coding format of this system will serve as the standard (Red Book G721). In this way, the digital system capacity becomes 3,840 circuits, which is more than 2,700 or 3,600 circuits and slightly less than 4,380 circuits.

Besides digitization of coaxial cables, building existing analog microwaves into digital microwaves is another important measure for digitization of analog networks. Studies have already been made in China. Development of some of the equipment was completed in 1986 and it has been examined and approved.

5. [as published] Building new trunk lines to integrate microwave satellites with optical cables. In regions where original analog trunk lines have not been developed yet or where existing trunk lines cannot satisfy demand after expansion of capacity, new trunk lines should be built. Detailed comparisons should be made of the type of transmission medium to be used in the new trunk lines. There is a tendency at present to ignore radio transmission while superficially considering substituting optical cables for electrical cables. The traffic in China will be less than that in the developed nations for some time to come. By summarizing many conditions, microwave and satellite transmission would be even more economical than optical cables. Some in foreign countries recently made detailed comparisons of these three transmission media, and the results of the comparisons converted into kilometers are shown in Figures 4 and 5. Figure 5 shows that, when there are 3,840 voice circuits (two 140-Mb/s systems), optical cables are cheaper than satellites if the circuit length is less than about 1,600 km. When the number of voice

circuits is even less, the circuit length must be much shorter. Figure 4 compares satellites and microwaves. When both have 3,840 voice circuits and the circuit length exceeds 4,000 km, satellites are cheaper than microwaves. When there are several hundred voice circuits and the circuit length is greater than 1,600 km, satellites are even cheaper. China has a vast territory and conditions vary from place to place. Since we may be faced with these traffic volumes and circuit lengths, we must choose between satellites, microwaves, and fiber optics. We should note that the traffic in China is not great at the present time, so it would not be best to build too many long-distance optical-cable trunk lines too early. Instead, we should make full use of and even expand microwave and satellite communications. When the traffic grows to the point where optical cables are the most economical, we can build optical cables and use the existing satellites for other cities. In this way, we would not have to be overly concerned with importing large numbers of optical-cable communications systems. We can wait for optical-cable-communications production lines to take shape in China and for further improvements in the technology, at which time we can use Chinese-made optical-cable systems to build long-distance trunk lines. This would reduce investments and save foreign exchange. Of course, we also should work on several experimental long-distance optical-cable segments at the present time.

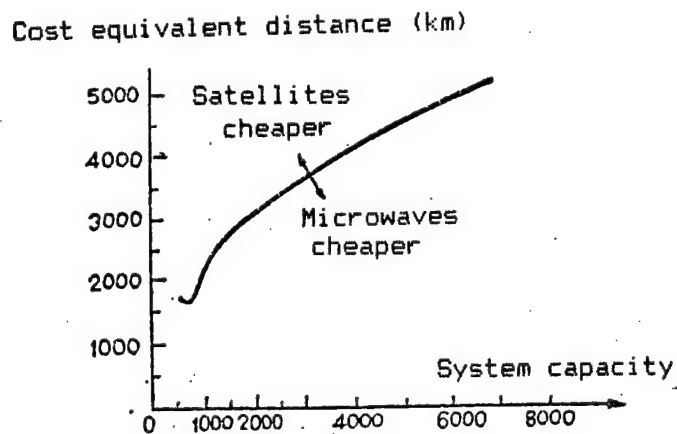


Figure 4

6. Actively develop intraprovincial communications networks. Open-wire lines account for a substantial part of China's existing long-distance analog communications networks, particularly intraprovincial communications networks. In some regions, although high-12-line circuits can be added to open-wire lines or a small number of circuits can be added, potential is limited, so new circuits must be built. With the exception of coastal and economically developed regions, the traffic in most provinces is small. Because of the small circuit capacity, the construction cost per kilometer of voice circuits is higher than that of trunk lines. Thus, we also should consider research on what type of transmission medium should be used to build new circuits.

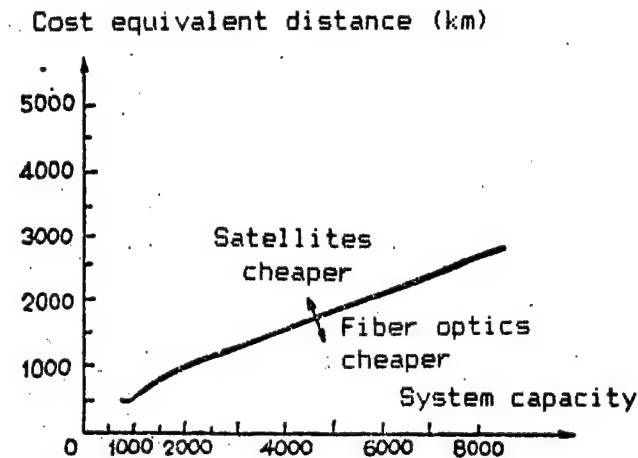


Figure 5

In the early 1980's, conversion of intraprovincial circuits to cables was debated and polystyrene-insulated aluminum core and aluminum-jacketed single four-circuit group cables were developed. The capacity of this type of cable was 2 x 132 circuits for dual cables and 2 x 60 circuits for single cables, which is more suited to the intraprovincial traffic at present. In the future, dual cables can be expanded in capacity into 900 circuits or converted to 480-circuit PCM systems. They have gone into trial operation in Fujian Province, with excellent results. Regions with a larger traffic also can use small coaxial cables, whose capacity and feasibility of digitization has been outlined above.

Following domestic production of optical cables, another solution would be to use 4- to 6-core multimode graded-index optical cables to open up 1.3  $\mu\text{m}$  34-Mb/s digital systems. This is now being tested.

Table 5 compares a 6-core optical cable with a 6-tube small coaxial cable system and Figure 6 compares a 4-core optical cable with a single 4-circuit group cable system. The tables show that building an optical cable system costs less than a small coaxial cable system, and that only when the small coaxial cable carries 960-line carrier waves is the cost per kilometer for each voice circuit less than that of an optical cable system. The cost of building a 4-core optical cable system also is slightly less than a single 4-circuit group electrical cable system, and only when the latter carries 900-line carrier waves is the cost per kilometer for each voice circuit less than that of an optical cable system.

Rising prices for nonferrous metals have led to stable increases in electrical cable prices, while the price of optical cable systems continues to decline. We must be earnest, therefore, when building new intraprovincial cables.

Table 5

Transmission medium		Six-core optical fiber	Six-tube small coaxial cable
Circuit capacity (two main, one reserve)	Analog	--	2 x 960
	Digital	2 x 480	2 x 480
Repeater distance (km)		23	4
Cost per km (direct burial) (10,000 yuan)		4*	513*
Cost per km for voice circuits (yuan)	Analog	--	27.6
	Digital	41.7	55.2

\*See "Explorations of the Feasibility of Using Fiber-Optic Communications for Intraprovincial Trunk Lines," DIANXIN KEXUE [Telecommunications Science] No 8, 1987.

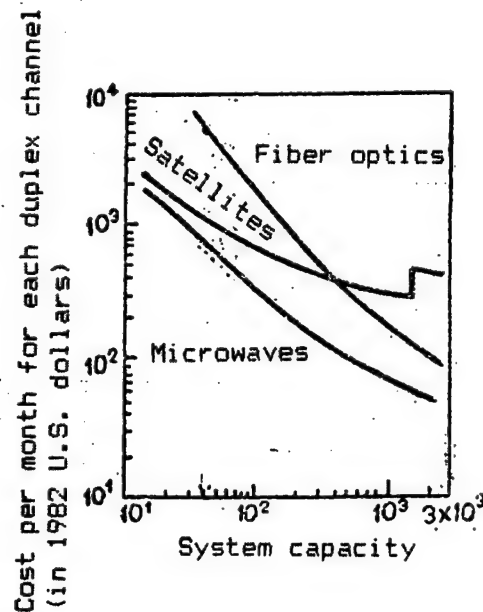


Figure 6

When the traffic is only a few dozen voice circuits, the capacity of 4-core optical cable obviously is excessive, so a transmission system with an even lower construction cost should be sought. An example is the adoption of frequency-division-band 4-circuit carrier wave systems. On the one hand, they do not require crosstalk prevention and can use simpler solid or foam polyvinyl insulation. When installed on existing overhead poles, a bonded aluminum-polyvinyl jacket can be substituted for an aluminum jacket. This can cut the cost of the electrical cable by one-half. On the other hand, it also reduces repeater costs since it eliminates directional filters in the repeaters. The construction cost of this kind of transmission system is reduced from the present figure of 23,800 yuan/km to 18,000 yuan/km, or 60

percent of the 4-core optical cable system. By initially opening a 60-circuit system (maximum frequency 552 kHz, repeater stage length 8 km) and afterwards reducing the repeater stages to 4 km, a 300-circuit system (maximum frequency 2.5 MHz) can be opened.

Of course, this type of transmission system has two shortcomings. First, it lacks a reserve system, and second, it is hard to digitize.

Another transmission medium for intraprovincial use is microwave (analog or digital). Foreign data show that microwaves are cheaper than optical fibers when circuits exceed a certain length. Figures 6 and 7 compare the monthly costs for each duplex channel in satellite, fiber optic, and microwave transmission systems in foreign countries. Figure 6 shows that microwaves are cheaper than optical fibers when the circuit length is 500 km. Longer circuit lengths are even more favorable to microwaves. It is apparent from Figure 7 that when the circuit capacity is 1,800 circuits, optical fibers are even more economical at 50 km and less. When there is a reduction in circuit capacity, this is even more favorable to microwaves. Moreover, since optical fibers are used for digital transmission, most intraprovincial communications in the near term will employ space division long-distance switching. Thus, when making economic comparisons, full consideration should be given to the additional costs of digital/analog conversion equipment as well as new demands for digital equipment maintenance personnel.

Table 6

Transmission medium			Four-core optical cable	Single four-circuit group cable		Single cable system
				Dual cable system		
				Initial period	End period	
Circuit capacity (one main, one reserve)	Analog	--	132	900	60	
	Digital	480	--	480	--	
Repeater distance (km)		23	12	4	10	
Cost per km (10,000 yuan)	Direct burial	3.6	3.8	4.6	--	
	Open-line	3.0	3.3	3.9	2.38	
Cost per km for voice circuits (yuan)	Direct	Analog	--	287.9	50.0	--
	burial	Digital	75.0	--	93.8	--
	Open	Analog	--	250.0	43.3	396.7
	line	Digital	62.5	--	81.3	--

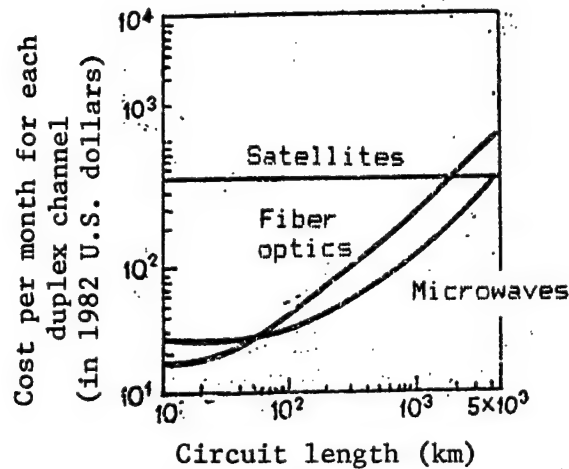


Figure 7

### Conclusion

In summary, the development of long-distance transmission in China at present should look first of all to full utilization of existing long-distance circuits (including open-wire cables and microwaves), and to expanding capacity and exploiting potential. At the same time, we should accelerate research on transmitting digital information in analog networks, implementing multiplex conversion equipment for digital/analog and analog/digital conversion, and rebuilding analog cables and microwave systems into digital systems. Building new trunk lines should be chosen in consideration of satellites, microwaves, and optical cables, and it would be best not to call prematurely for constructing many long-distance optical-cable trunk lines. We should actively develop intraprovincial communications systems, and we should compare microwave and optical cable systems. Of course, in the area of microwaves, we should make the necessary analyses of digital microwaves and analog microwaves, and it is possible that there may be a need to develop a simple cable carrier wave system suitable for a small traffic volume to reduce construction costs.

12539/6091



An Efficient Algorithm for Block Implementation of Exact Recursive-Least-Squares Problems

40090115a Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 9 No 3, May 88 pp 7-14

[Article by You Xiaohu [1429 5135 5706] and He Zhenya [0149 2182 0068] of Department of Radio Engineering, Nanjing Institute of Technology]

[Abstract] An efficient algorithm for block implementation of exact recursive-least-squares [RLS] time-sequence problems is presented. The new algorithm differs from Cioffi's block FTF algorithm in that there is no suboptimal criterion introduced when the information is carried from block to block. (Theoretically, the data block length is unlimited and its length can be varied in realtime). This shows that our algorithm has the same convergence rate as the commonly used exact RLS algorithm, but the computational volume of the former is only a fraction ( $2/7$  to  $1/5$ ) of that for the fast RLS algorithms, such as the FTF (Cioffi, 1984) and the FAEST (Kalouptdis, 1983) algorithms. In addition, the present algorithm also exhibits a numerically stable property due to the new iteration version adopted. The algorithm is evaluated for adaptive equalization and real-time identification of AR parameters. A shortcoming of this algorithm is its lack of real-time tracking capability to a certain extent.

Four figures show a flowchart of the block implementation algorithm, variation curves of mean multiplication times versus data block length, curves of error variance versus iteration times, and curves of output noise variance versus iteration times. Four tables show the definition of internal iterative parameters, derivation of the algorithm, and a flowchart of the reconstruction algorithm with the LS solution at any time. References 19: 18 English, 1 Chinese.

You Xiaohu is a doctoral candidate at the Department of Radio Engineering, and He Zhenya is a professor at the department. The authors are grateful to Dr. J.M. Cioffi of Stanford University for his constructive suggestions. The paper was received for publication on 11 November 1986.

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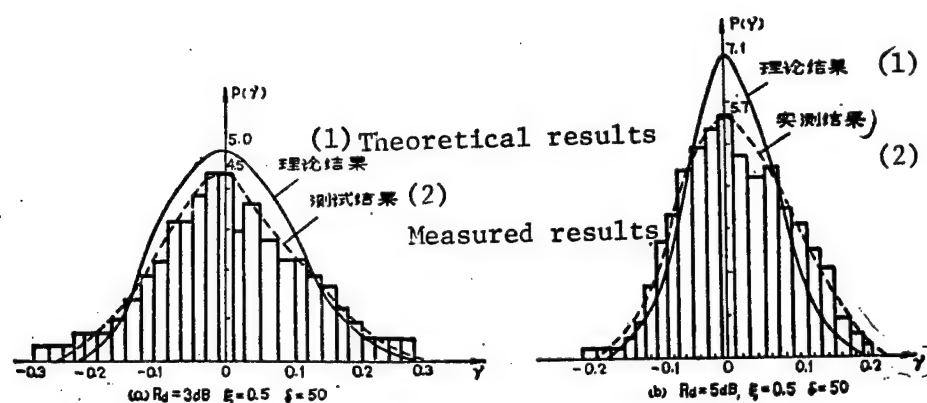
Tracking Performance of Second-Order Delay-Locked Loop

40090115b Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 9 No 3, May 88 pp 35-42, 71

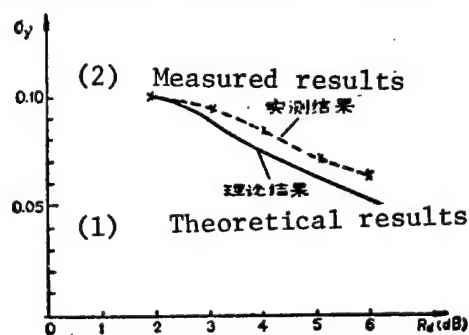
[Article by Liu Zengji [0491 1073 1015] of Northwest Telecommunications Engineering Institute, and Wang Jiangzhou [3769 3068 5297] of Nanjing Institute of Technology]

[Abstract] The tracking performance of high-gain, second-order, delay-locked loops (DLL) for PN code chip synchronization in spread-spectrum communication receivers is theoretically analyzed and calculated by means of Fokker-Planck equation. Additionally, some test results of an experimental model are given. The paper computes the probability density and variance of steady-state synchronization error, thus obtaining some meaningful results. In the second section of the paper, loop equations of noncoherent DLL and definitions of various parameters are presented. The third section discusses the steady-state tracking performance of high-gain second-order DLL, and presents the analytical method and its results. The fourth section gives the test results for an experimental model for the tracking performance of high-gain second-order DLL.

After compilation and analysis, the testing results are shown in two figures below. At every signal-to-noise ratio, the number of sampling points is selected as 200. It is apparent in the figures that the experimental results and theoretical data are in quite close agreement when the signal-to-noise ratio is relatively high (the signal-to-noise ratio of unitary data ( $R_d$ ) is greater than or equal to 3 dB); the experimentally measured root variance ( $\sqrt{\sigma}$ ) of the synchronous error is approximately 10 percent greater than its theoretical value. This deviation is mainly caused by noise within the loop.



Histogram of Synchronous Error  $\gamma$



Measured Results of  $\delta\gamma$ .

Eight other figures show a noncoherent DLL, its noise equivalent phase model, unitary-equivalent discriminating-phase property, a source-ratio integrating filter, probability density and root variance of the steady state synchronization error, an experimental model of second-order DLL, and the measured unitary-equivalent discriminator-phase property. References 4: 3 English, 1 Chinese.

Liu Zengji is a professor at the Northwest Telecommunications Engineering Institute; he presented several papers. At present, he is engaged in teaching and research on data and computer communications. Wang Jiangzhou is a doctoral candidate at the Institute of Radio Engineering, Nanjing Institute of Technology in 1986; he was awarded a master's degree at the Northwest Telecommunications Engineering Institute. The paper was received for publication on 17 February 1987.

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Optimal Data Rate in Meteor Burst Communications

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[Article by Ma Wei [7456 3452] and Bao Zhou [0545 3166] of Northwest Telecommunications Engineering Institute, Xi'an]

[Abstract] Meteor burst communications (MBC) is an over-the-horizon type of scatter propagation in the very high frequency (VHF) band. Utilizing meteoric ionization trails at high altitudes of 80 to 120 kilometers as the scattering body, the propagation distance may be somewhat beyond 2,000 kilometers. The paper analyzes the performance of an MBC system. It is proposed that the mean waiting time should be used as a specification in representing the performance. The concept of optimum instantaneous data rate in terms of minimum mean waiting time, and its design method are presented.

At present, the data rate in an MBC system is invariant. Thus, designers always face a problem in selecting a data rate. For a major category of systems with a fixed data length (such as data transmission in a meteorological data collecting network, radar and navigation), optimal system performance can always be attained by using the design method presented in this paper. However, for data with varied lengths as applied to general communication, only a compromise suitable data rate can be selected rather than an optimal rate. Thus, the authors are anticipating a system with an automatically adaptable data rate. The system can change its data rate with varying meteor trail ionization density to consistently maintain the optimal state for the system.

The single figure in the paper shows a meteor communication model. References 10: 7 English, 2 Chinese and 1 Japanese.

Ma Wei is a teaching assistant at the Northwest Telecommunications Engineering Institute. He was awarded a master's degree by the institute in 1984; from 1986 to 1987, Ma visited the United States for advanced studies at the University of California. Bao Zhou is an associate professor at the institute. The paper was received for publication on 1 March 1986.

10424/12223

## Radio Wave Propagation for Communication of Submarines Beneath Ice-Layer

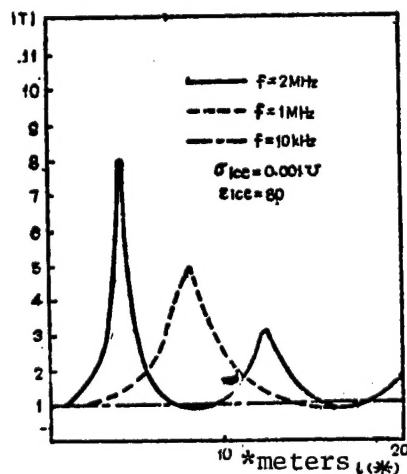
40090115d Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 9 No 3, May 88 pp 74-78

[Article by Pan Weiyan [3382 1218 3508] of China Research Institute of Radio Wave Propagation]

[Abstract] The paper discusses the propagation attenuation of radio waves in two different cases as follows:

1. Very low frequency (VLF) waves are transmitted by a VLF transmitter at the ground surface; the waves propagate in the earth-ionosphere waveguide, reach the ice layer out in the sea, then penetrate vertically into the ice layer and sea water, and arrive at a receiving antenna on the submarine.
2. Medium frequency (MF) or high frequency (HF) waves are transmitted by a horizontal trailing antenna of the submarine beneath the ice-layer; waves travel vertically upward through the ice-layer, then propagate along the ice-layer, penetrate vertically into the ice-layer again, and reach the receiving antenna of another submarine.

The paper calculates the effect of different ice-layer thicknesses on radio wave propagation attenuation and attempts to determine the range in which frequencies of general communication lie. A figure shows the variation of the transmission coefficient  $T$  within a given ice-layer thickness.



Five more figures depict the propagation path from a transmitting station to a submarine beneath an ice-layer, wave reflection over the ice-layer, a physical model (showing atmosphere, ice layer and sea water beneath the ice), curves of variation in the unitary surface impedance of the ice surface with ice-layer thickness, and a curve of variation in distance for a horizontal electric field produced by a unit horizontal dipole.  
References: 7 English.

Pan Weiyan is a senior engineer at the China Research Institute of Radio Wave Propagation. In 1966 he completed postgraduate work at Chengdu Institute of Telecommunications Engineering in radio physics. From 1983 to 1985, Pan was in the United States as a visiting scholar for advanced studies at Harvard University. He is presently engaged in research on electromagnetic pulse propagation. The paper was received for publication on 3 November 1986.

10424/12223

Circuit Unit of the Center Node in a Star-Type Local-Area Network With Multiple Access Capability

40090115e Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 9, No 3, May 88 pp 79-82

[Article by Lu Zhaoyi [6629 2507 5030] of Lanzhou University, and Tadao Saito [7871 4696 1813 1133] of Tokyo University, Japan]

[Abstract] Research into and the manufacture of the star-type LAN [local area network] for fiber-optic communications have advanced in the past two (or three) years. Multiple access capability is a new method of accessing a star-type LAN. The paper describes one of the star-type LAN center nodes in the accessing mode and discusses the operating principle of this center node as shown in one of three figures.

Two other figures show the structure of the channel selector circuit, and the corresponding output waveforms from triggers and gate circuit with off-on time (as well as delay time and switching time) listed in the single table. References 4: 3 Japanese 1 Chinese.

Lu Zhaoyi is a lecturer at Lanzhou University; he was graduated in 1966 at the university (radio physics specialty in the physics department). In years before and after 1985, Lu was in Japan for advanced studies at Tokyo University. He authored JISUANJI JUBUWANG JICHU [FUNDAMENTALS OF COMPUTER LOCAL AREA NETWORKS] and other books, and also presented several papers. At present, he is mainly engaged in research on information transmission theory, data packet exchange theory, and satellite television for educational purposes. Tadao Saito is a professor at the Department of Electrical Engineering, Tokyo University. His research includes computer local area networks, data packet exchange, network operating systems and processing of natural languages. The paper was received for publication on 20 February 1987.

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New Derivation of an Adaptive LMS Algorithm

40090115f Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese Vol 9 No 3, May 88 pp 91-93

[Article by Xi Jiangtao [5045 3068 3447] of Zhengzhou University]

[Abstract] The long-held theory of the LMS (least mean squares) algorithm contradicts the signal cancellation phenomena and cannot explain the practical convergence properties in certain cases. In the paper, the LMS algorithm is newly derived based on the minimization of the time average of square error. The practical convergence law of the LMS algorithm is derived with an outcome that is in accordance with practice.

It is pointed out that the adaptive LMS algorithm does not require a Wiener optimal filter as the target; therefore, there is a basic distinction between the actual performance of the adaptive filter and the optimal Wiener filter. In the latter case, the optimal state is attained statistically in the input random process; in the former case, the optimal state is attained for each specimen in the random process. In the new theory, contradictions between practice and the classical theories of signal cancellation phenomena and convergence property become satisfactorily reconciled.

A single figure in the text shows an adaptive noise cancelling system.  
References: 5 English.

The author is a lecturer and concurrently vice chairman of the Department of Electronic Engineering, Zhengzhou University. Xi was awarded a master's degree in 1985 at the Department of Radio Engineering, Qinghua University. He is currently engaged in teaching and research on telecommunications and electronic systems. The paper was received for publication on 10 April 1987.

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